ENGINEERING AND PRODUCTION IN METALWORKING JULY 1960

Machinery

see page 29, USI Clearing DIVISION OF U.S. INDUSTRIES, INC.

30" HEALD ROTARY

surface grinds

rotary index tables

with

GREATER ACCURACY
and
BETTER FINISH

. . . and up to five times faster, too!

On this Heald Model 361 30" Plain Rotary Surface Grinder, rotary indexing tables for other high-precision machine tools are ground flat and parallel within .0002", and to a surface finish of 15 micro-inches or better. Cast iron tables from 10 to 30 inches in diameter are easily handled, as well as a variety of miscellaneous parts.

Although high production was not a requirement, this Rotary enabled parts to be finished up to *five times faster* while obtaining greater accuracy and better finish than could be obtained with previous methods.

An adjustable wheel dresser built into the wheel-guard permits truing the wheel without resetting the wheelslide or moving the table. And a demagnetizing switch facilitates setup and unloading.

Heald offers a complete line of high-precision rotary surface grinding machines with chuck sizes from 6 to 30 inches and either manual or automatic reciprocation. Ask your Heald engineer for complete details, or send for a copy of Bulletin 2-361-1 Issue 2.

It PAYS to come to Heald

MMT-PE

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

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HEALD®

JULY 1960

VOL. 66 No. 11

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BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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SOLVE YOUR

LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA • U. S. A.

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

THREADING PROBLEMS IN CHICAGO

The coming Machine Tool Exposition in Chicago, September 6-16, offers you a personal on-the-spot opportunity for solving any day-to-day problems you may have in the production of THREADS . . . . .

NEW EQUIPMENT— see the *new* LAN-NU-ROL Thread Rolling Machine in a completely automated threading operation, featuring automatic bar feeder and receiver unit.

NEW METHODS— see the *new* LANHYROL Thread Rolling Machine in the unique roll-straightening operation—duplicating the one now producing 4500 parts per hour in the plant of a large automobile manufacturer.

NEW IDEAS— Let LANDIS Engineers tell you about the untapped possibilities for production and profit with the *only* complete line of Thread Rolling Equipment—Machines, Attachments, and Heads!

and-IN ADDITION— there will be Thread Cutting and Tapping equipment in operation producing threads in both conventional and unusual applications. And—the complete line of the World's Largest Selection of Threading Tools will be displayed for your inspection.

DON'T MISS THIS wonderful opportunity at Booth 432 for a personal give-and-take discussion of your threading operations. Trained Threading Engineers will be available throughout the Exposition to analyze your problems and make suggestions for improving quality, increasing production, cutting costs.

583C

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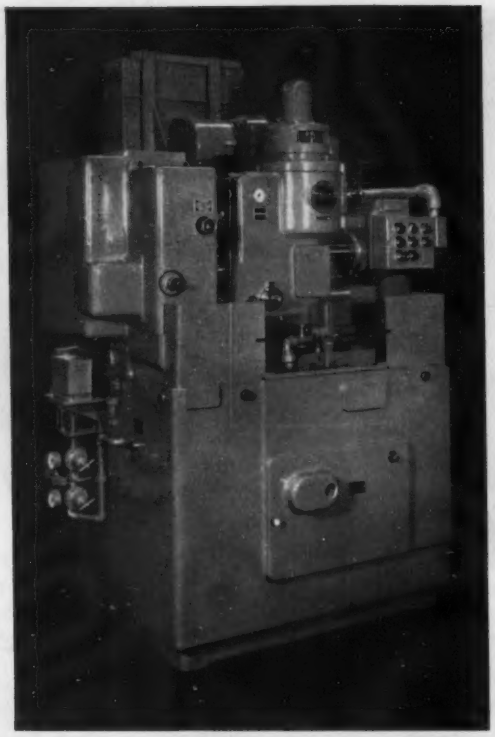
INVOLUTE GEARS

FELLOWS

NON-INVOLUTE PARTS



Fellows
4GS Gear Shaper

GEAR SHAPERS DO DOUBLE DUTY

Fellows Gear Shapers are not limited to the production of gears alone. They are valuable production machines ideal for the manufacture of *many* types of parts, of both involute and non-involute form.

As gear shapers, they provide high production rates in the manufacture of internal and external spur and helical gears. As general purpose production machines, they also make possible the economical production of irregularly shaped parts . . . in many cases doing in one simple operation what would require several operations using conventional shop tools.

If you manufacture gears in your plant, chances are the Fellows Gear Shaper is already an important part of your production process. If you manufacture irregularly shaped parts, find out how the Fellows Gear Shaper can help you increase production and cut costs.

Your Fellows representative will be happy to give you further information on the complete line of Fellows production and inspection equipment. Ask him, or write direct.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont, U.S.A.
Branch Offices:
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150 West Pleasant Ave., Maywood, N.J.
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THE PRECISION LINE

Fellows *Gear Production Equipment*

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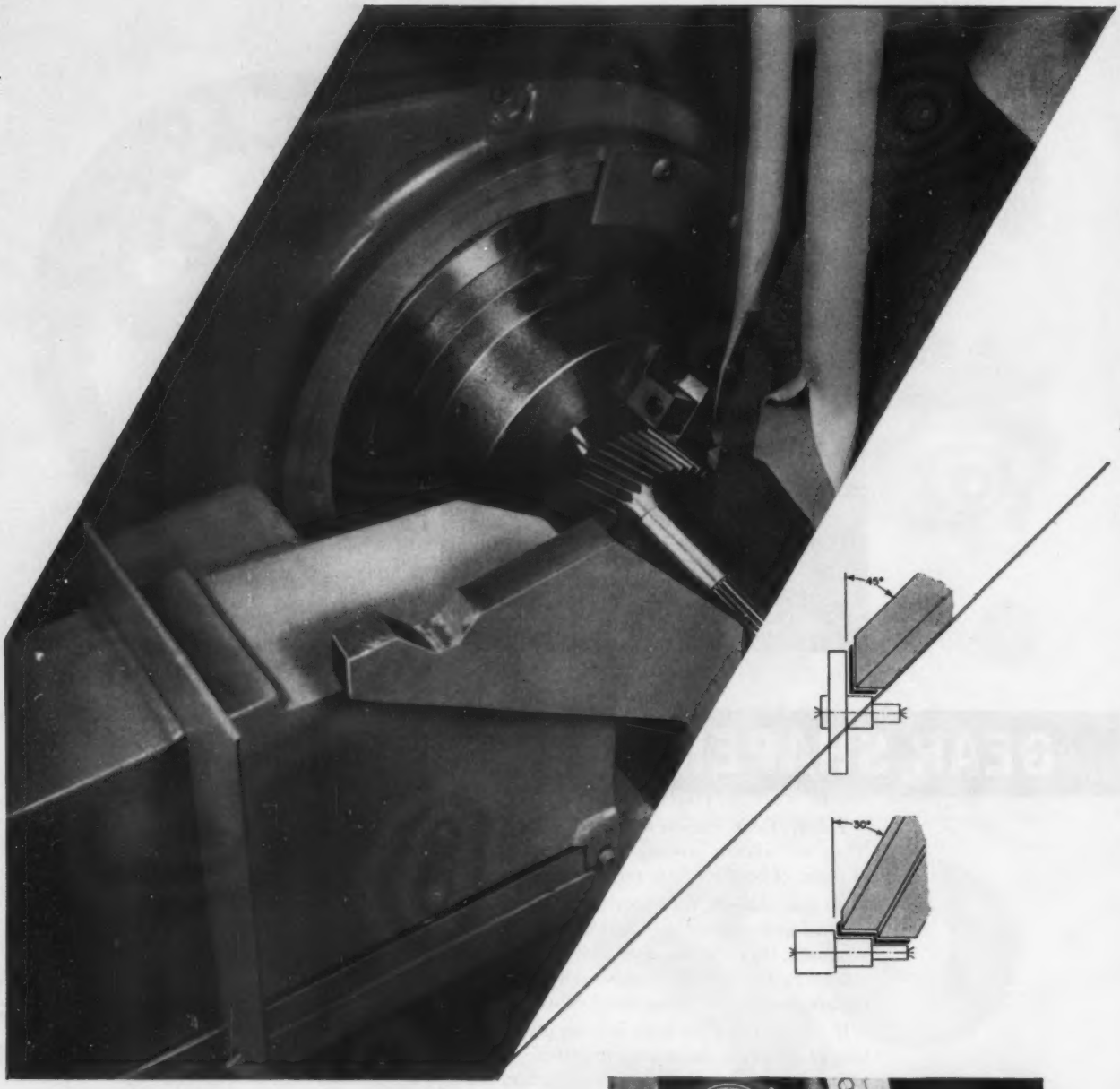
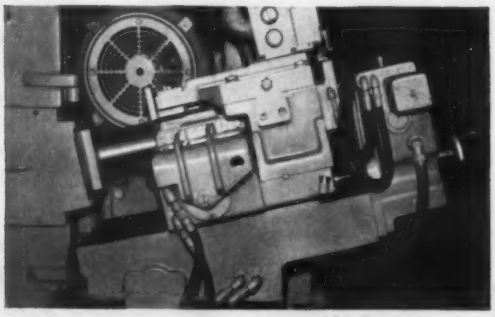


A long diameter and the adjacent face of drive gears are precision ground on a CINCINNATI FILMATIC Angular Wheel Slide Grinding Machine equipped with automatic sizing and flagging combined.



Wheel Truing Unit, push-button operated from front of machine. Balanced hydraulic system and two-way truing assure precise duplication of cam contour in face of wheel.

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

CINCINNATI GRINDING MACHINE DIVISION checks all the Angles...

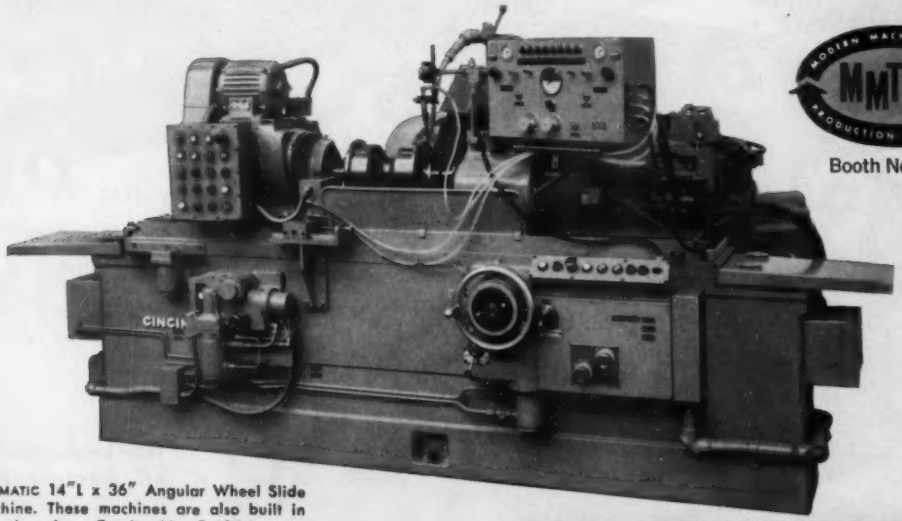
to combine diameter and shoulder grinding operations profitably

Like other methods of machining, precision grinding operations often can be combined at a substantial saving in cost. However, factors other than the mere combining of operations must be considered. Accurate wheel truing heads the list. Cincinnati Grinding Machine Division Specialists solved the problem in a unique and highly successful manner for angular wheel slide grinding.

The wheel is *automatically* trued to exact profile by merely pushing a button at front of the machine. A balanced hydraulic system, incorporating longitudinal and transverse cylinders under control of a directional integrating valve, assures sensitive, precise duplication of the cam contour in the wheel. Profile slide way is anti-friction; no twist, no stick-slip.

Combined diameter and shoulder grinding operations are analyzed from every angle by Cincinnati Grinding Specialists. These men have two wheelhead arrangements on which to base their recommendations —30° for diameters having a length considerably greater than the height of the shoulder, and 45° where height of shoulder equals or exceeds length of ground diameter.

Other feature-advantages include an automatic infeed cycle that incorporates rapid approach, coarse feed and fine feed rates for sizing and finish. For extra high production work where stock allowances are inconsistent, the Gap Eliminator cuts down the time spent in "grinding air." Automatic sizing and flagging are highly desirable quality control features. Complete details are in catalog No. G-686-1. May we send you a copy?



CINCINNATI FILMATIC 14"L x 36" Angular Wheel Slide Grinding Machine. These machines are also built in 6" and 10" swing sizes. Catalog No. G-686-1.

MMT-PE

Booth No. 1034

• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

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at the MTE...
see the outstanding features of the

a NEW

be sure to see
LANDIS
the years aheadline of
precision grinders . . .

▲ New Landis 6" semi-automatic type R plain cylindrical grinder

◀ New Landis type R universal cylindrical grinder

MMT PE

LANDIS
PRECISION GRINDERS

. . . now Landis offers the only new complete line of Plain and Universal Grinders with all these features. All new designs engineered for precision and production . . . not features hung on or added to an obsolete design.

allNEW wheel feed:
at eye level with turning handwheel during grinding feed for easier setup and operation

allNEW plain grinder truform dresser:
with both slides on preloaded balls for exact profiling

allNEW beds:
no hydraulic oil or open drains in bed—maintains better machine alignment

allNEW plain grinder footstock:
preloaded ball spindle for no shake and maximum stability

allNEW universal internal fixture:
compact, swing type—easy to position

allNEW universal feed:
for semi-automatic operation

and MICROFEED
a major breakthru in size control—available on these machines

LANDIS

world leader in precision grinders

Landis Tool Company, Waynesboro, Pennsylvania

U.S. MULTI-SLIDES®
BUILD PROFITS...
PIECE-BY-PIECE

Hour after hour, day after day, U. S. Multi-Slides are producing perfect pieces like these — by the hundreds of thousands. A single cycle of the machine produces a FINISHED formed stamping. Secondary operations and expensive handlings are eliminated.

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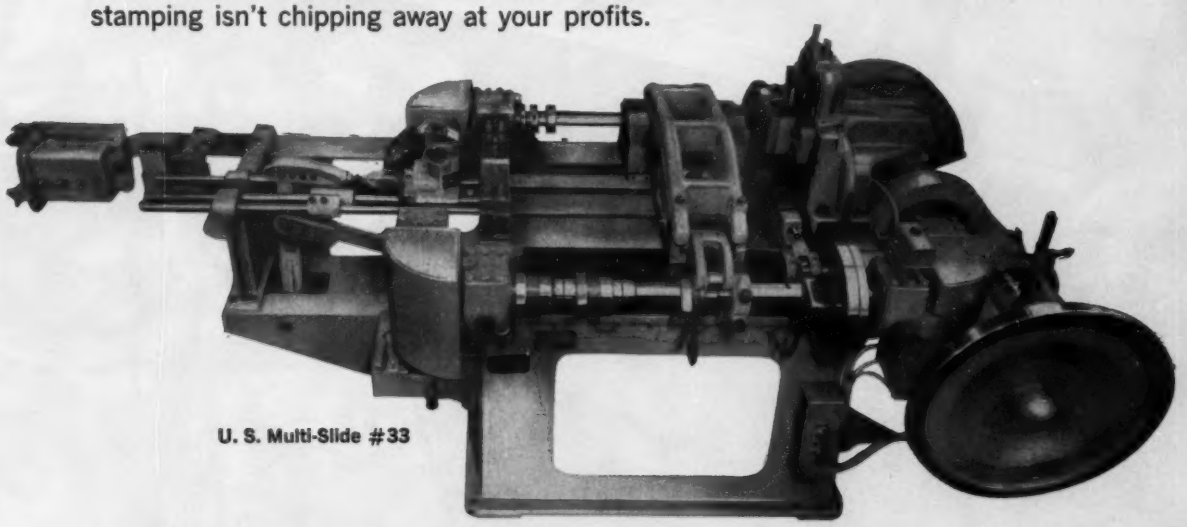
Unless you are now using U. S. Multi-Slides, you can't be sure your present method of stamping isn't chipping away at your profits.



U. S. Multi-Slide #33

To be certain, send us samples and "specs" of the stampings you are now making, or submit specifications of projects you are considering. Let us give you the facts of "piece-by-piece" profit through advanced U. S. Multi-Slide methods . . . you will be under no obligation.

Write today for Bulletin 15-M.

MMT-PE

Visit us at Booth 805

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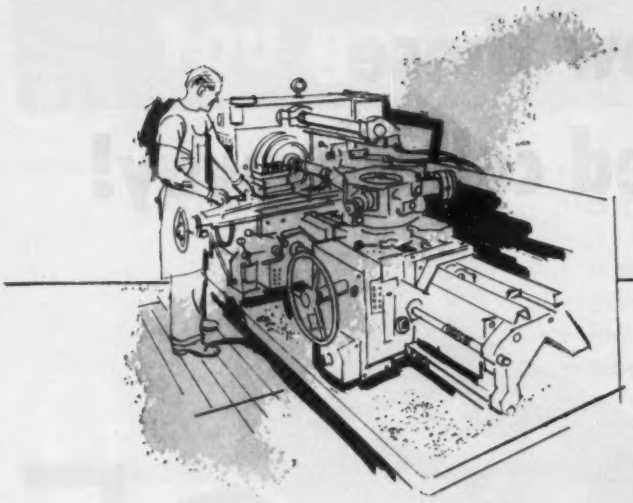
U. S. TOOL COMPANY, INC.

AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

Unique Section Template was one idea which Hobart tooling specialists came up with to reduce setup time and minimize template costs. A short template was made up to handle a range of shafts with similar ends. Various length middle sections could then be quickly inserted to obtain various lengths and shoulder locations. A three-section template is shown in use on the machine in upper photo. The interchangeability feature of the template sections is shown at left. Two pieces of this four-section template—the section marked "2⅛ Shaft" and the spacer section held in hand—are also used in the above setup.



AT HOBART BROTHERS COMPANY
TROY, OHIO

Warner & Swasey 2-A with contouring cross slide

- *Slashes setup time*
- *Combines auxiliary operations into one setup*
- *Produces shafts at 1948 cost levels*

HOBART BROTHERS CO.—a leading producer of arc welding equipment and aircraft ground-power units—faced a serious production bottleneck. Long setup time on their older turret lathes and excessive part handling time was crippling the small lot production of motor-generator shafts. Because their production scheduling for 77 different models of arc welders, 20 models of ground-power units, plus numerous specials, is tied directly to sales, lot sizes frequently had to remain small—usually from 1 to 20 pieces.

Hobart launched a three-pronged attack to solve the problem by:

1. Installation of a new Warner & Swasey 2-A Saddle Type Turret Lathe equipped with a hydraulically-controlled cross slide contour unit.
2. A creative tooling approach to reduce set-up time.
3. A thorough time and motion study to insure efficient utilization of daily production time.

As a result, Hobart Brothers today are producing shafts at 1948 production costs!

Contributing to the success of this efficiency study and modernization program was their new contour cross slide equipped Warner & Swasey 2-A which permitted:

- **Setup time to be slashed—from 2 hours to 20 minutes.**
- **Combining of center drilling, facing and threading operations into a single, efficient turret lathe setup reducing part handling time.**
- **Production time savings averaging 35% because of higher horsepower and spindle speeds, and elimination of extra hex turret and square turret handling time. All diameters and grinding reliefs are produced directly from the template.**
- **Holding closer tolerances which reduced grinding time and extended grinding wheel life.**

Check today with your Warner & Swasey Field Representative. He'll gladly tell you how the cost-cutting results of the "Hobart Story" can be a reality on your own operations.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

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Throw those old-fashioned collets away!

Now you can afford to equip your

Atlas SHELDON **DELTA** **SOUTH BEND** *Logan*

lathes with the world's most modern collet chuck and its Rubber-Flex® Collets

$70.00

Model 50 Collet Chuck

$65.00

Complete Set of 10 Rubber-Flex Collets

You get a lot more for less!

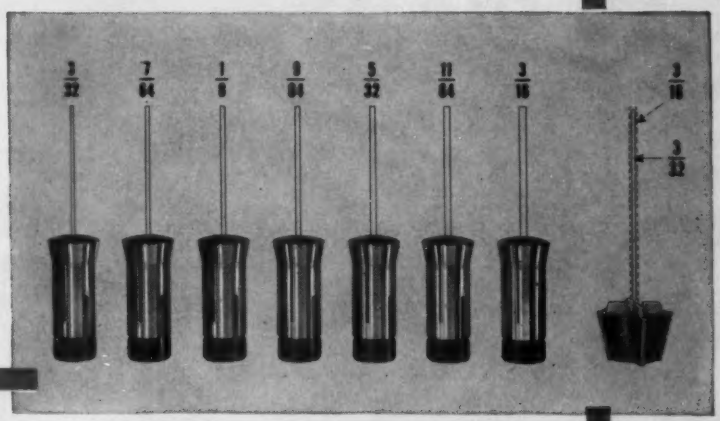
model 50

- is a brand new nose type handwheel chuck
- is quicker to operate
- is easier to operate
- is more accurate
- develops more torque
- increases lathe capacity
- mounts directly onto your spindle
- costs less . . . less . . . less . . .

A lot more for a lot less...

$70.00
for the chuck!

$65.00
for the collets!
($6.50 each)



An entirely new series of ten Jacobs Rubber-Flex Collets has been developed along with the world's most modern collet chuck. Rubber-Flex collets do more because:

- **Jaws are always parallel for greater accuracy . . . maximum runout .001".**
- **Extra long bearing surfaces have stronger grip.**
- **Only 10 collets chuck all bar sizes—3/32" to 1 1/16"—.100" range per collet.**

How one Rubber-Flex collet replaces seven split steel collets

This is the chuck,
these are the collets,
for your . . .

ATLAS • DELTA • LOGAN
SHELDON • SOUTH BEND
. . . lathes

See your Jacobs industrial supply distributor. Let him prove these fantastic facts with a convincing demonstration at your desk! Call him today.

Jacobs CHUCKS

JACOBS MANUFACTURING COMPANY • WEST HARTFORD, CONNECTICUT

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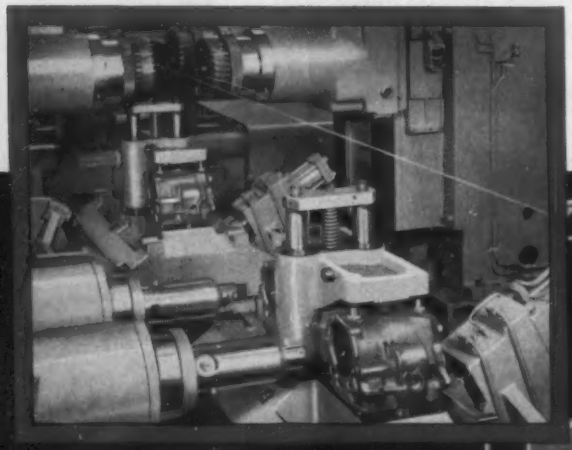
Cross Introduces Automation for High Precision Boring and Facing

Many Unusual Features in New Transfer-matic for Machining Transmission Cases



Finish boring the front and rear main bores with one bar to assure concentricity.

Operations include boring the main shaft, counter shaft, reverse idler, and two shifter rod bores and precision facing both ends.

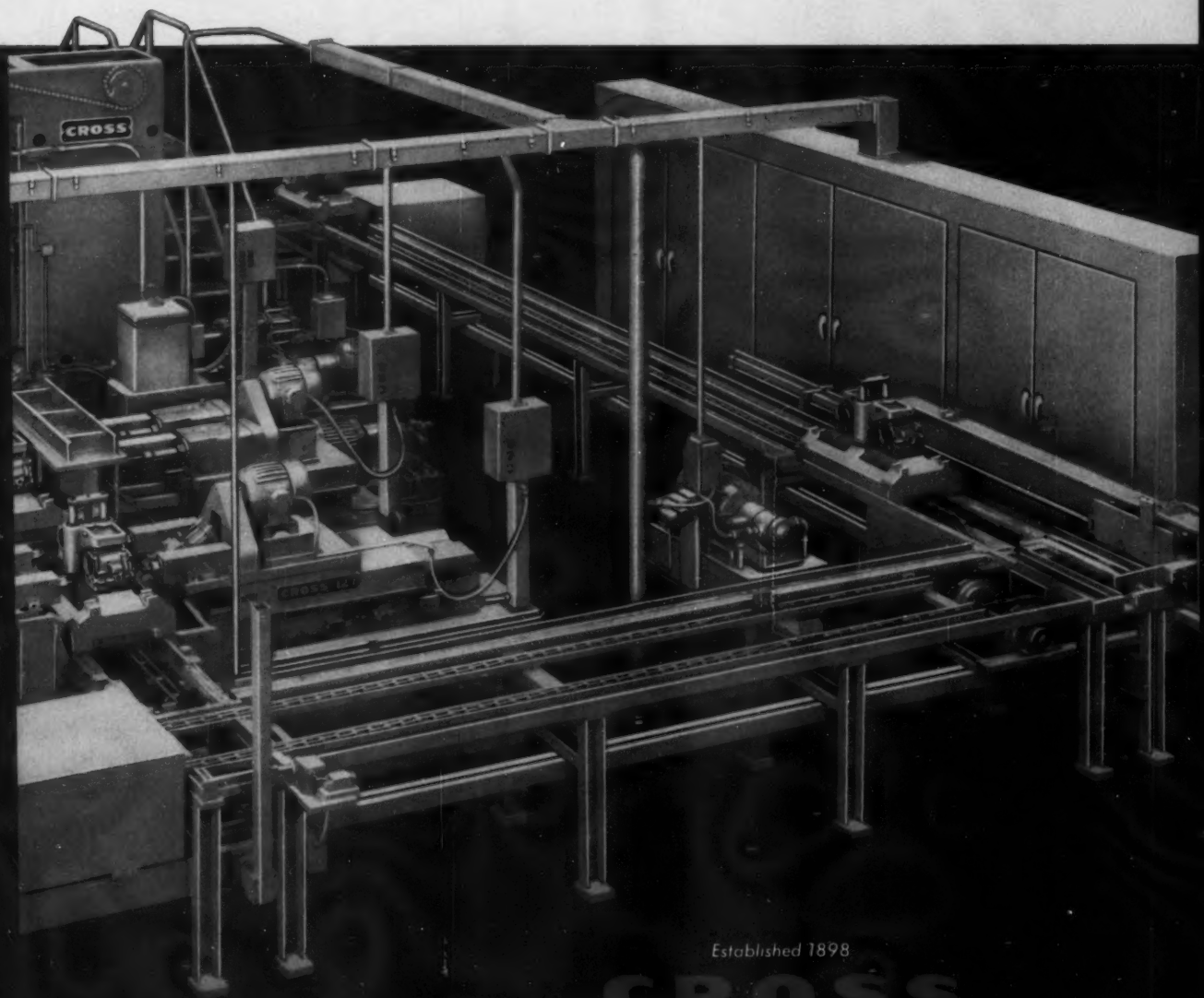
Another Automation First by Cross

An unusual new Transfer-matic which applies the production economies of automation to high precision finishing has been designed by Cross. It bores and faces transmission cases at a rated capacity of 140 parts per hour despite the rigid accuracy.

Some bore sizes are held to tolerances of plus or minus 0.00035 inch and chordal dimensions between three holes are held within plus or minus 0.001 inch. Squareness between the ends and bores is maintained to 0.0005 inch. Surface finish specifications are 56-110 micro-inches, rms.

A number of special features have been developed to assure this high precision. Center bases and wings are integral to obtain the rigidity necessary for maintaining precision alignment. Pallet locating is designed to assure extreme accuracy from station to station. Strategically placed air jets check the position of the pallets in each station.

A Cross sales engineer will be glad to explain details of this unusual Transfer-matic and other Cross innovations.

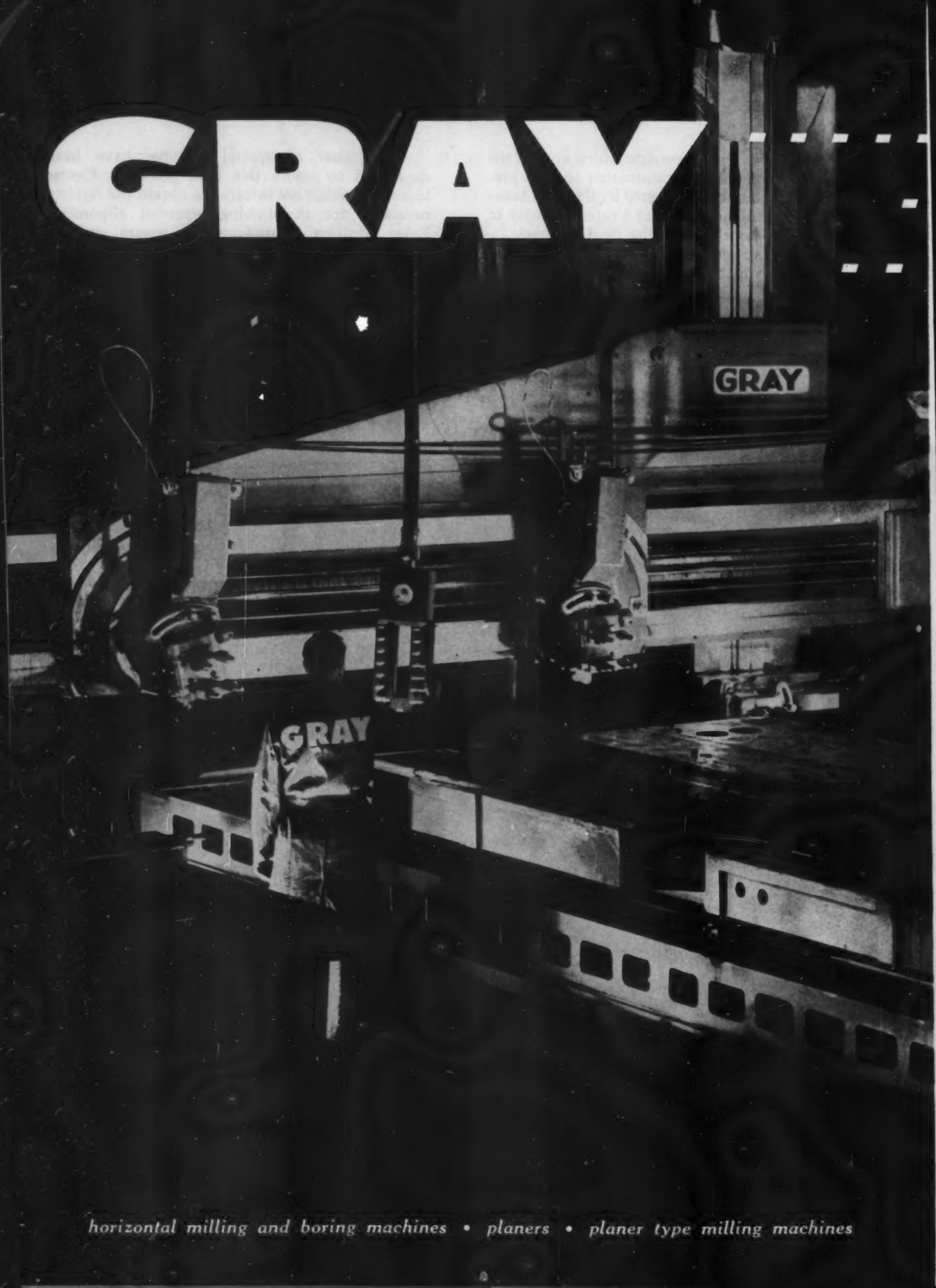


Established 1898

THE CROSS CO.

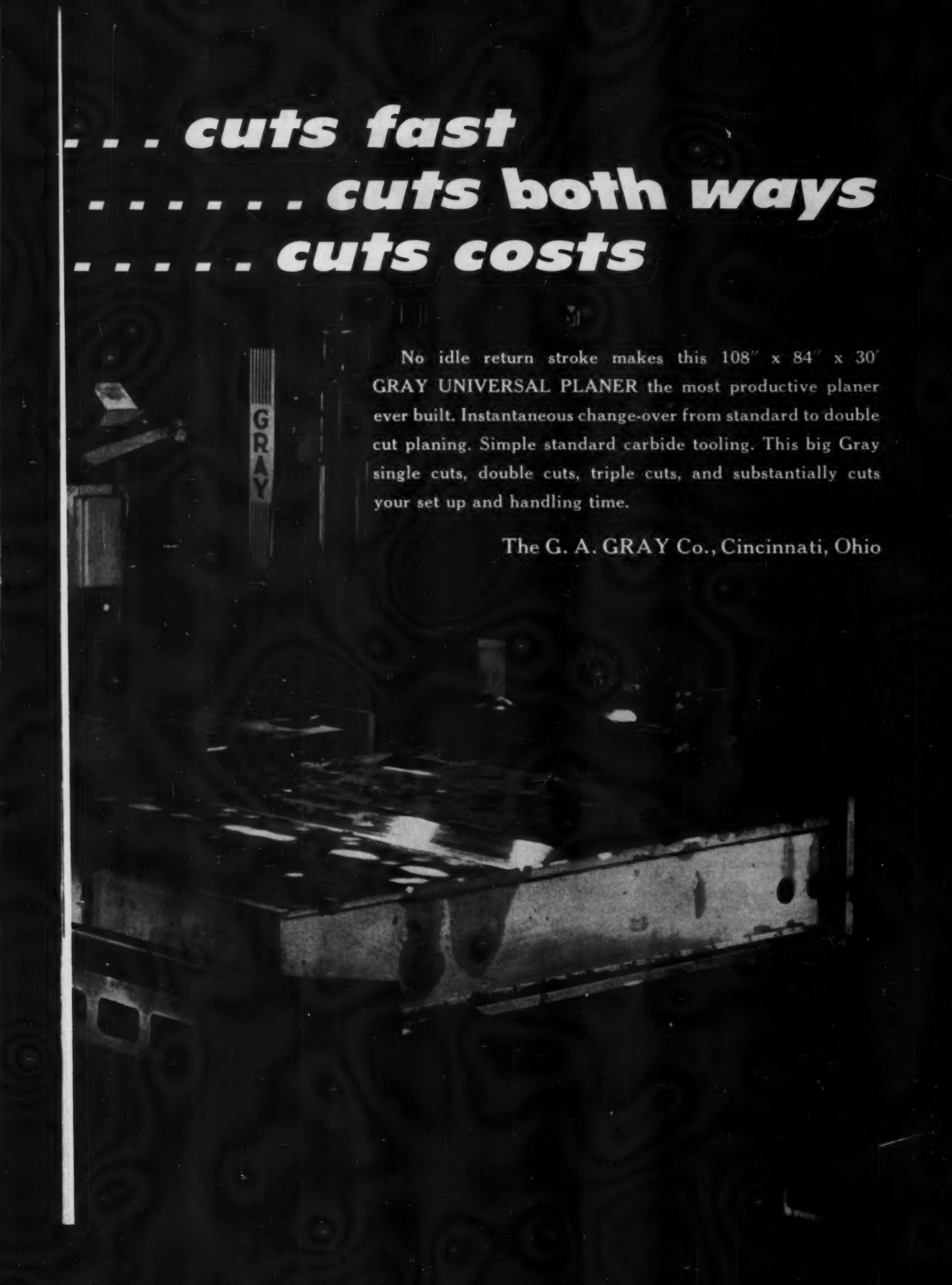
First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN



horizontal milling and boring machines • planers • planer type milling machines

. . . cuts fast
. . . . . cuts both ways
. . . . . cuts costs



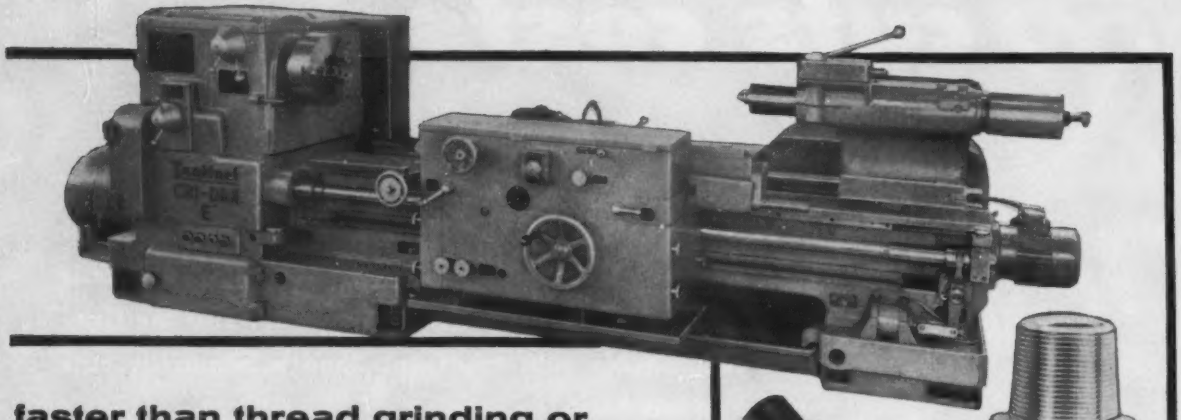
No idle return stroke makes this 108" x 84" x 30' GRAY UNIVERSAL PLANER the most productive planer ever built. Instantaneous change-over from standard to double cut planing. Simple standard carbide tooling. This big Gray single cuts, double cuts, triple cuts, and substantially cuts your set up and handling time.

The G. A. GRAY Co., Cincinnati, Ohio

CRI-DAN

(Semi-Automatic Single Point)

THREADING LATHES...



faster than thread grinding or milling...handles toughest jobs on hardest materials at less cost--distributed by

GISHOLT

Widely used throughout Europe and rapidly gaining favor in the U.S.A., CRI-DAN High-Speed Threading Lathes offer outstanding advantages on a wide variety of threading work. Using single-point carbide tools and positive, cam-controlled movements, CRI-DAN provides very accurate lead and thread form on all types of internal and external threads, including multiple-start, coarse, fine, left- or right-hand, parallel or taper, with metric or inch pitches. Highest production, accuracy and fine finish are assured on even the most difficult materials.

With simple operation and 15 minute change-over, CRI-DAN is an extremely versatile machine capable of handling an amazing range of components at high production rates. Single-point carbide tools, easily resharpened or replaced, cut tooling costs to a minimum.

Two models are available with a full complement of accessories to meet your needs. Ask your Gisholt Representative for full details or write

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

MMT-PE

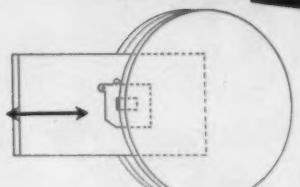
Investigate Gisholt's Extended Payment and Leasing Plans

Turret Lathes • Automatic Lathes • Balancers • Superfinishers Threading Lathes

Gardner gun type fixturing lowers costs in grinding large area and odd shaped parts

surface grinds TWO sides parallel in ONE operation

Gardner 2H30 Precision Double Spindle Grinder with gun type fixturing.



Typical large parts ground with gun type fixturing:
clutch races, bearing cones, valve plates, separator plates, deposit box doors, pump rings.

Advantages of Gardner reciprocating gun type fixturing

- heavy stock removal
- work holding paddles easily interchangeable
- profitable for short runs
- tolerances for flatness, parallelism and uniformity to "tenths"

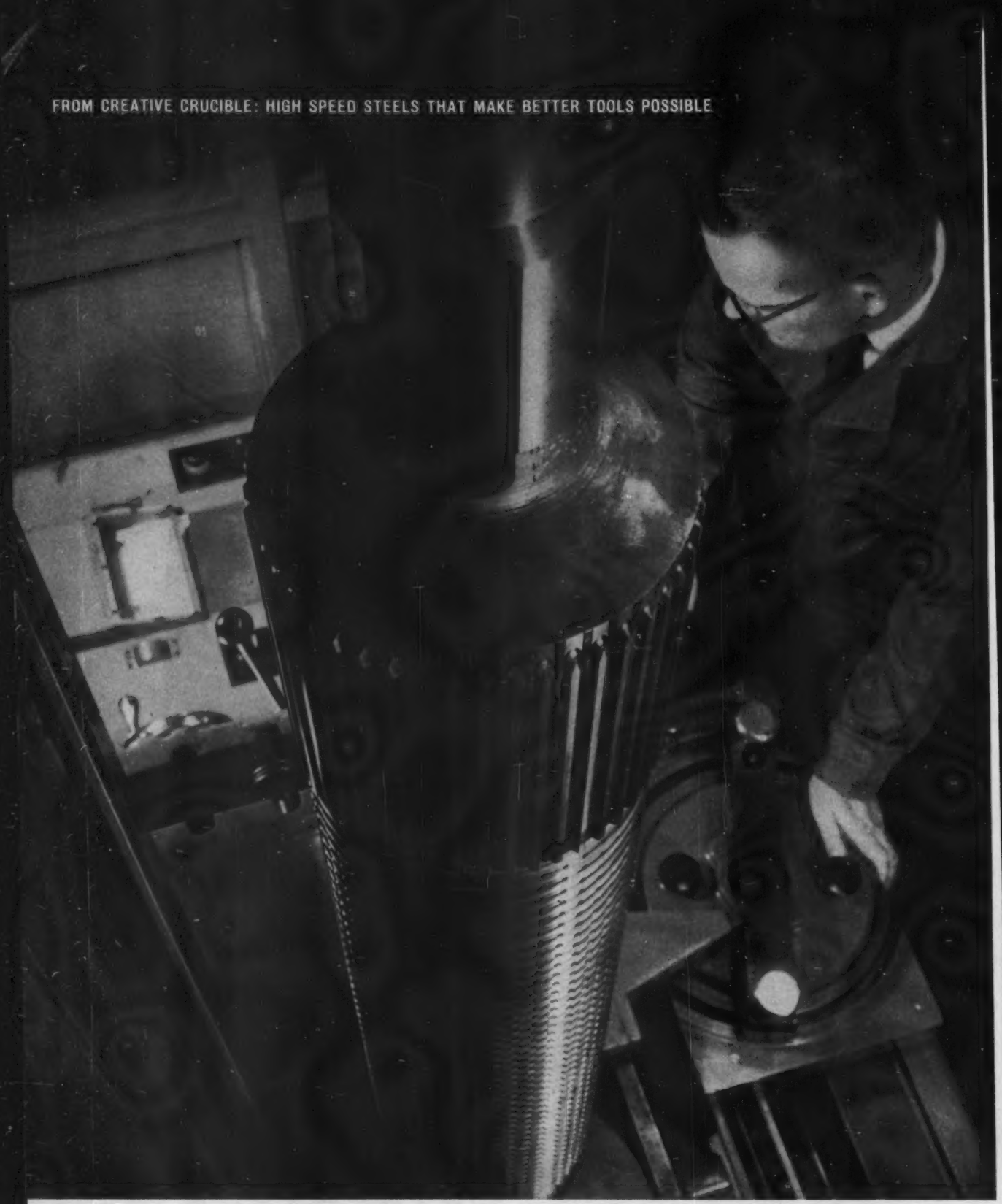
Ask the Gardner Man for practical recommendations or write for latest catalog.

GARDNER

precision disc grinders

BELOIT, WISCONSIN

FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE



CHECKING THE INVOLUTE PROFILE OF A SPLINE BROACH. Broach's 6" pitch diameter is designed to cut 48 splines—hold accuracy of +.0002"-.000" on all splines for 30". This accuracy is possible on broaches up to 82" when made of Rex High Speed Steel.

NOW, BROACHES PRODUCE MORE PIECES FASTER

They're also producing pieces with finer finishes and greater accuracy – because they're made of continually-improved Rex® High Speed Steels.

New broach designs and new broaching machines now enable you to mass-produce complex shapes in a matter of minutes. Furthermore, every piece is finely finished to within micro-inch tolerances.

What is behind this development? It's the increased skill of the broach tool makers, combined with Crucible's progress in making better high speed steels.

To produce the fine steels needed for broaches, Crucible tool steel specialists make use of the most advanced electronic instrumentation available today. For example: they use precision instruments to control the temperature of the molten metal in the melting furnace. So, each heat is produced under identical conditions.

CHECKING THE TOOTH SPACING OF HELICAL INVOLUTE SPLINE. Finishing teeth on broaches made of Rex High Speed Steels reproduce shapes within tolerances of a few ten-thousandths of an inch.

Crucible tool steel specialists employ new techniques that greatly improve deoxidation of the liquid steel. They also use new ingot mold designs that provide freedom from segregation when the steel solidifies. And they ultrasonically inspect every billet of Rex High Speed Steel before rolling or forging.

Today Rex High Speed Steels continue to make the best broaches because they offer *1.* more uniform distribution of carbides throughout the section. This ensures minimum size change, greater predictability in heat treatment, greater hardenability and more uniform hardness in the heat-treated tool. And *2.* more uniform distribution of sulfides in the free-machining grades—which provides improved machinability and superior surface finish.

To make precision tools better with Crucible's Rex High Speed Steels, call or write the nearest Crucible branch office or warehouse.

BETTER TOOLS, THROUGH BETTER STEELS. The constant improvement of Rex High Speed Steels ensures the increasingly better performance of hobs, taps, twist drills and cutters—as well as broaches.

CRUCIBLE STEEL COMPANY OF AMERICA

Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, N. J. • Charlotte Chicago • Cincinnati • Cleveland • Columbus • Dallas • Dayton • Denver • Detroit • Erie, Pa. • Grand Rapids • Houston • Indianapolis • Los Angeles Miami • Milwaukee • Minneapolis • New Haven • New York • Philadelphia • Pittsburgh • Portland, Ore. • Providence • Rockford • Salt Lake City San Francisco • Seattle • Springfield, Mass. • St. Louis • E. Syracuse • Tampa • Toledo • Tulsa

Allis-Chalmers uses **RYKON** *Grease in bearing shield—offers farmers better disc harrow*

can **RYKON** Grease help you improve your product?

Above: Maynard Walberg sweeps sand back over disc harrow bearings on test stand. RYKON Grease is undergoing 2,000-hour test in this simulation of actual farm service conditions.

Below: Allis-Chalmers disc harrow ready for shipment from the plant gets inspection from Standard's Fred Parkinson and Walberg.

Maynard Walberg, Allis-Chalmers project engineer, and Standard Oil lubrication specialist Fred Parkinson, examine disc harrow bearing assembly. Fred is well equipped through training and experience to help industrial customers with lubrication problems. He has been doing this work for 11 years at Standard. He has a degree in chemistry and engineering from Brown University. Plus that, he has completed the Standard Oil Sales Engineering School.

Situation: Bearings of a disc harrow in service are always turning in dusty conditions, oftentimes completely covered with soil. Such bearings in the Allis-Chalmers harrow are protected with grease-coated rubber shields. The grease guards against dirt getting past the shield and into the bearing.

What was done: Allis-Chalmers project engineer in the LaCrosse, Wisconsin plant, Maynard Walberg, called Fred Parkinson, Standard Oil lubrication specialist, for a sample of RYKON Grease. In conditions simulating field service, RYKON Grease was tested. Bearings were rotated in the most abrasive dirt available—Mississippi sand with a high quartz fraction.

What happened: Tests were started and run to destruction. Prior to the use of RYKON Grease, bearing failures occurred at 500 hours. On switching to RYKON Grease, these tests were pushed to 2,000 hours. At this point, tests were stopped. Bearings were still in operating condition.

What you can do: Find out how RYKON Grease might help you offer your customers a better product. Inquire of the Standard Oil lubrication specialist nearest you anywhere in the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 So. Michigan Ave., Chicago 80, Ill.**

STANDARD

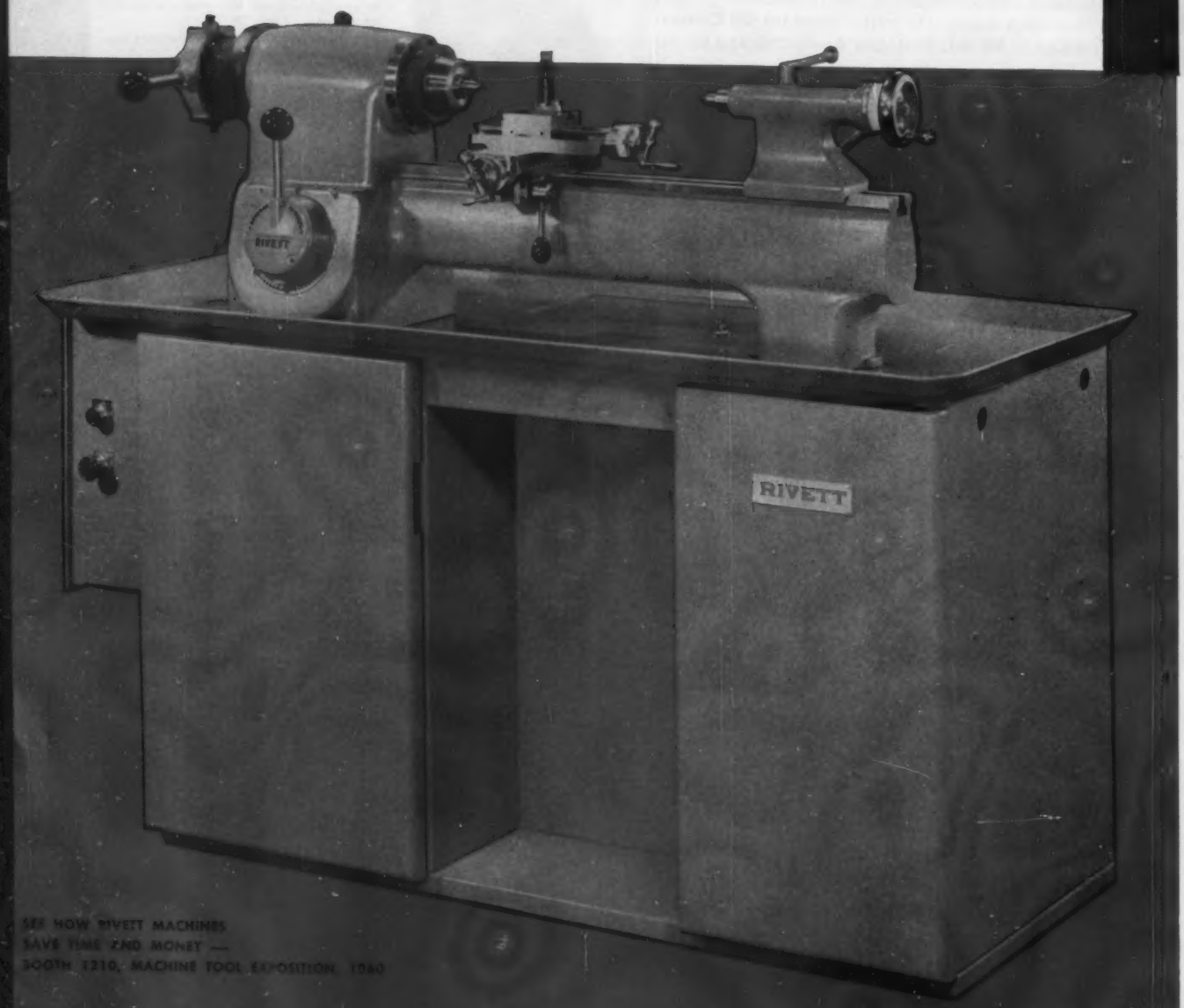
You expect more from STANDARD and you get it!

Quick facts about RYKON

- Heat stable. At sustained high temperatures RYKON Grease remains soft and grease-like.
- Resistant to water-washing.
- Mechanically stable. Minimum change in consistency in service.
- Resistant to oxidation. Thickener acts as an inhibitor.
- Exceptional rust-preventive properties.

RIVETT

helps you prepare for the 60's with its...



SEE HOW RIVETT MACHINES
SAVE TIME AND MONEY —
BOOTH 1210, MACHINE TOOL EXPOSITION, 1960

ALL NEW SIXTY series

precision speed lathe!

Here is a production tool of speed, accuracy and durability that combines the perfection of the most modern material and engineering skill with the know-how of three generations of lathe building experience.

RIVETT

Featuring "one motion control"

1 Single lever starts lathe spindle and selects any speed within the range up to 4800 r.p.m. Same lever will change speed during operation or instantly stop or reverse spindle. Stops may be set for repeating selected speeds on duplicate work.

No waiting during speed selection or speed change. There is greater ease of operation, less handling time, and an opportunity for greatly increased production.

And 4 other Rivett "Firsts" for more precision work on a greater variety of jobs!

2 **NEW BED FORM FEATURES DOUBLE-BEVEL AND DOVETAIL.** Double-Bevel positively centers tailstock in alignment with headstock and the large bearing area prevents below-center wear. Dovetail aligns compound slide rest and evenly distributes its bearing on top of bedway as tool pressure pulls against inverted dovetail.

3 **SPINDLE WITH TRUE ROUNDNESS AND RIGIDITY.** Large diameter super-precision ball bearings of highest quality fitted to in-line ground mountings assure near-perfect roundness. Constant bearing preload, unchanged by speed or heat, holds spindle rigid against both side and end pressure of cutting tool. Unusually heavy wall and wide bearing spacing contribute to spindle's rigidity.

Endless vee belts replaced without disassembling spindle. 1-½" collet.

4 **COMPOUND REST WITH HARDENED STEEL SLIDES.** All mating slides are machined from steel, then fully hardened and ground. Feed screws will continue free from backlash; they are ball bearing mounted and have heat treated threads turning in nuts which automatically compensate with wear.

Contrasting black markings on white dials record feed of cross slide "on diameter" and feed of compound slide in direct linear motion.

A clamping handle located in front for maximum convenience aligns and locks slide rest to bed's top surface and dovetail.

5 **DISTORTION-FREE MOUNTING.** Uneven or non-rigid floor cannot distort lathe. Bed has three-point mounting on a steel channel isolated from any distortion of cabinet.

RIVETT LATHE & GRINDER, Inc.

Dept. MA-7 Brighton 35, Boston, Massachusetts

Fine tools that encourage Good Work

ARMSTRONG WRENCHES

SEE US AT BOOTH 238
PRODUCTION ENGINEERING SHOW
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If you don't know your local ARMSTRONG Distributor, we will send you the names of those in your area.

An ARMSTRONG Wrench feels right—is balanced. It goes over nuts or screw heads easily, grips firmly without sloppiness, won't round corners—because openings are carefully machined to correct sizes. It's safe, strong beyond need without clumsy bulk—because of superior design and selected steels, heat treated to proper degree of hardness and tensile strength. It's quality finished, ARMALOY (alloy steel) Wrenches in chrome plate with heads buffed; HI-TEN (carbon steel) Wrenches in baked-on gray enamel with heads ground bright . . . all plainly marked for size. All are uniformly excellent tools manufactured under strict quality control, by modern methods, with modern equipment in a modern tool plant . . . 1537 different industrial sizes and types—single wrenches, or sets in metal cases, boxes or rolls . . . each a quality tool. Armstrong Wrenches are "Fine tools that encourage good work."

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about the cover

If You Are Not Sure What Types of Presses Will Do The Most Productive Job for You—See Clearing

Want to know how one company protected themselves against possible equipment obsolescence? Have you heard how some companies have overcome the problem of downtime for die changing? These are some of the subjects you'll find in the more than fifty (count them) pieces of literature Clearing has available for you.

Check the subjects or subject you are interested in, or check the films your company may be interested in seeing. We'll send the material promptly and without obligation.

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Mechanical Presses • Hydraulic Presses • Torc-Poc O.B.I. Presses • Axelson Lathes • Harrison Lathes • Special Equipment for Aircraft and Missiles Mfg. • Dies • Torc-Poc Drives

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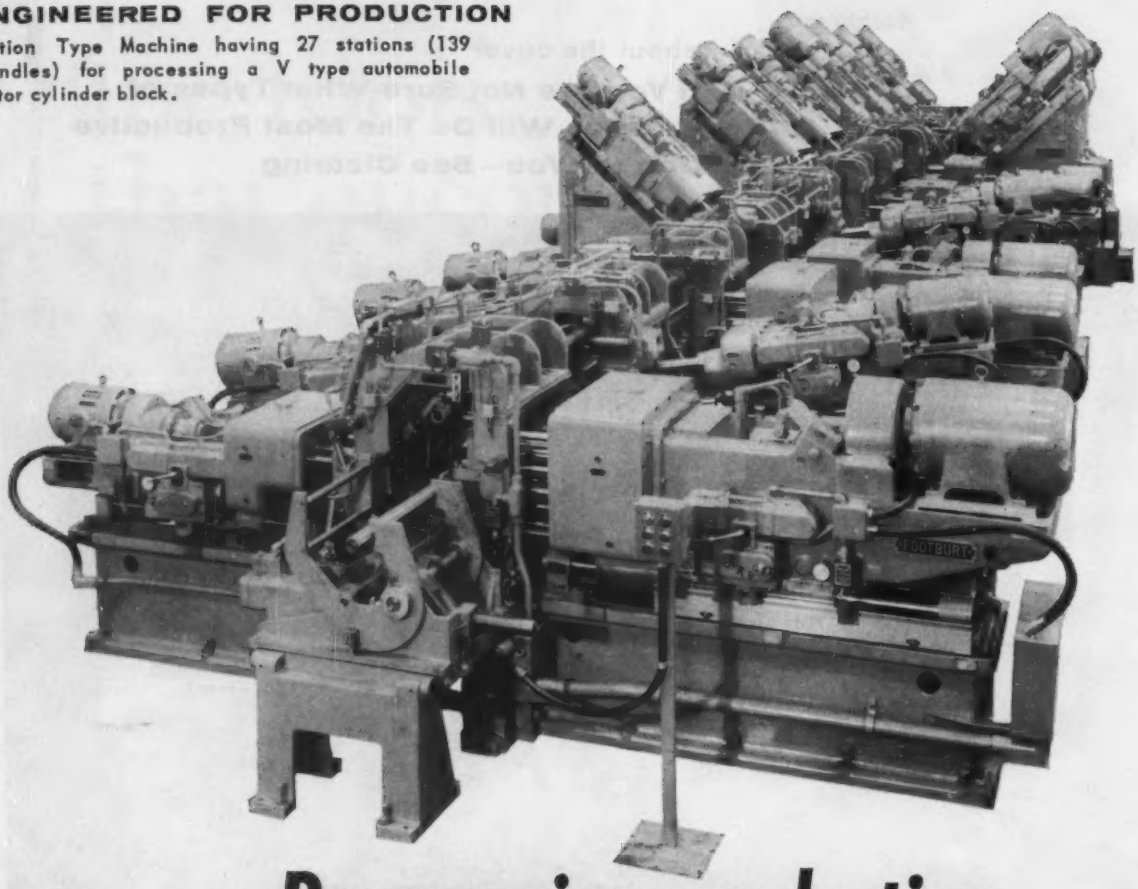
ENGINEERED FOR PRODUCTION

Station Type Machine having 27 stations (139 spindles) for processing a V type automobile motor cylinder block.



Progressive production . . .

FOOTBURT station type machines

The Footburt circular shows many exclusive features.

With the Station Type Machine, Footburt continues to provide the most modern developments in production machinery.

Drilling, reaming, tapping, milling, checking and testing may be combined in one station type machine, and units may be mounted at any angle.

Installations of Footburt Station Type Machines have been made in many leading automotive plants, in some case handling the major machining on the block and head components.

THE FOOTE-BURT COMPANY, Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

FOOTBURT

MACHINE TOOLS

For more data circle this page number on card at back of book

Helixform*—a new method for bevel gear production!

The new No. 12 Hypoid Helixform Gear Finisher assures improved quality and increased production on spiral bevel and hypoid non-generated ring gears up to 10½" in diameter, and 2½ DP such as employed in passenger car axles.

The Helixform Cutting Method used on this machine offers these advantages:

Conjugate tooth surfaces, minimized gear development, complete control of tooth bearing, and greater adjustability in final assembly.

We will be glad to send a bulletin giving further details on request. Ask for literature on the No. 112 Hypoid Helixform Gear Finisher and the companion No. 112 Hypoid Gear Rougher. Write for it today.

*Trade-Mark

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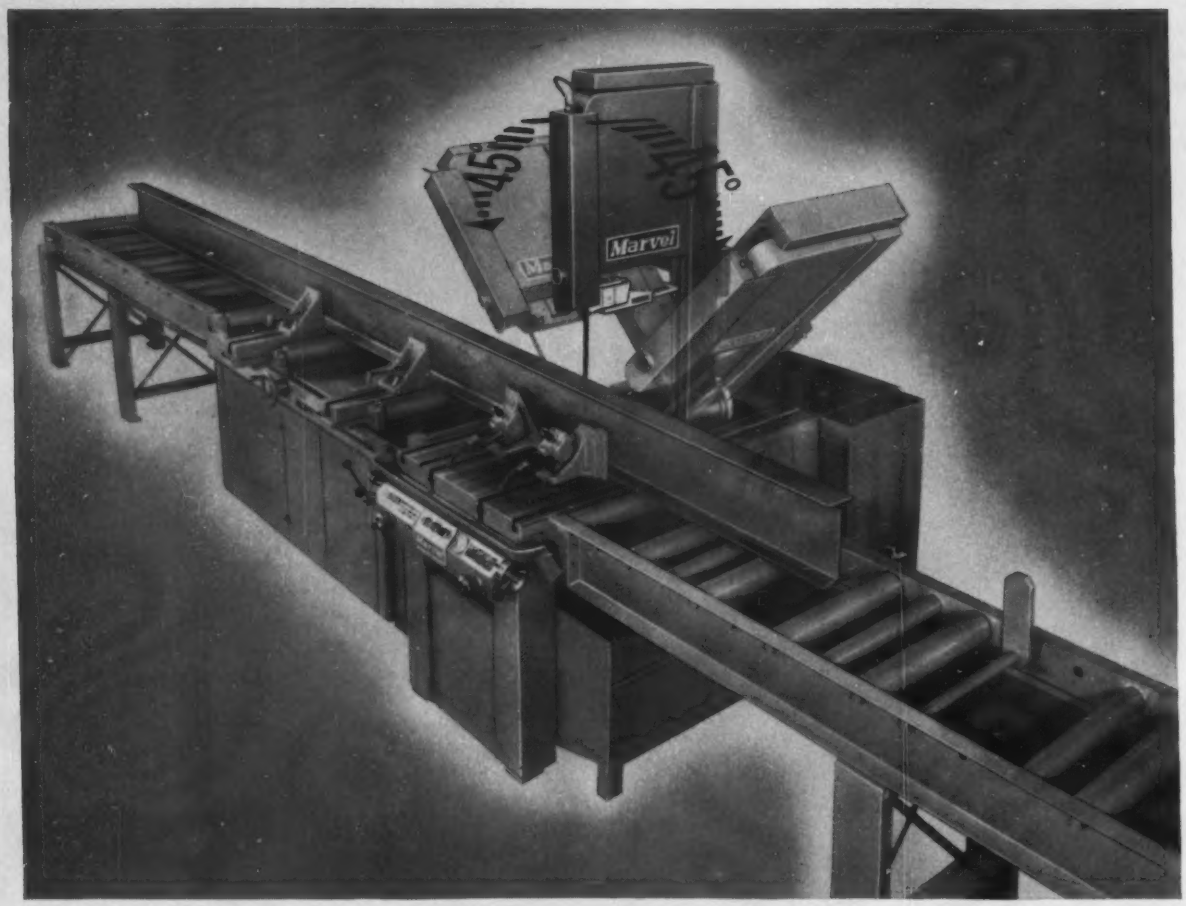


Tips Its Head To Cut Production Corners

Sawing 45° miters in any kind of material has always been a simple task for MARVEL Saws, but moving the work up automatically and making consecutive cuts on an angle was a problem, especially when the work was long and cumbersome.

This triple exposure photograph of a new MARVEL No. 81A All Hydraulic Heavy Duty Automatic Bar Feed Band Saw, illustrates how the upright head or column can be tipped 45° either right or left of vertical to make angle or miter cuts. The work is held stationary while the column, which carries the blade, is fed forward, meeting the work squarely to insure accurate cutting. After the cut is completed, the work is automatically moved up and measured, and another cut made.

Automatic miter cutting is just one of many exclusive universal features of these band saws. Designed to utilize every advantage of high speed steel band blades, MARVEL No. 81 Series Band Saws can handle almost any conceivable sawing job—from the smallest, most delicate work, up to 18" x 20" shapes.

Only the MARVEL No. 81 Band Saws have the "SURE-LINE" Automatic Accuracy Control (basic patent applied for) which literally steers a blade to make a straight cut. This unit extends usable blade life as much as 50%.

MARVEL No. 81 Series Band Saws are proving themselves daily, as the most versatile machine tools in production metalworking plants.

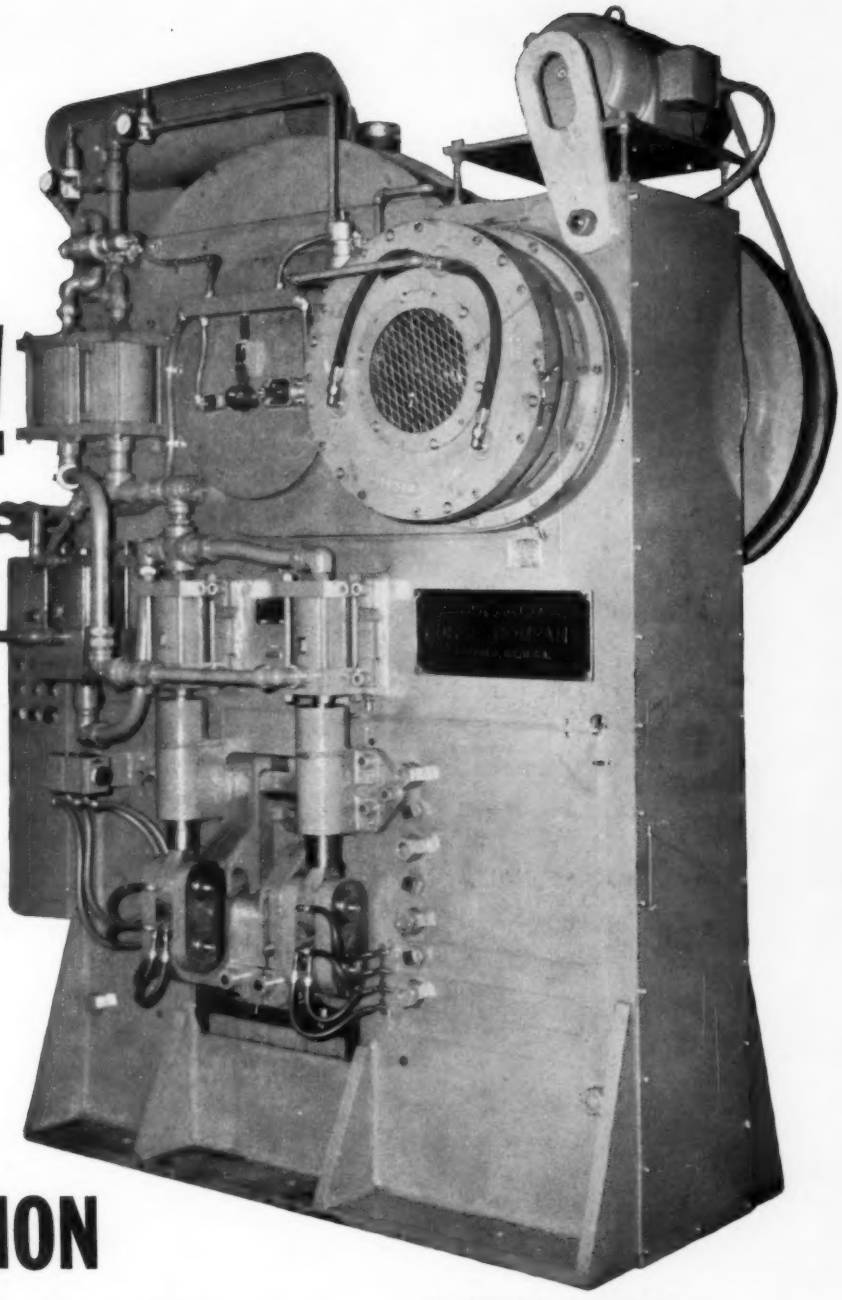
For complete details, or a demonstration of MARVEL Sawing Equipment, write: Armstrong-Blum Manufacturing Co., 5700 W. Bloomingdale Ave., Chicago 39, Ill.

MMT-PE

MARVEL Metal Cutting SAWS

Better Machines-Better Blades

FAST!



'BUFFALO' 400 BILLET SHEAR

Up to 18,000 Cuts per 8 Hour Shift

THAT'S PRODUCTION

Discover how the *New* 'Buffalo' 400 Billet Shear can save time and boost production on your billet cutting operations. Contact your machine tool dealer, or write direct.

SPECIFICATIONS

Ram Tonnage	400 tons
Strokes per minute (free running)	60
Round Billets, Mild Steel	4½" dia.
Square Billets, Mild Steel	4" sq.
Flat Bars	12" x 2"
Knife Size	3" x 7½" x 13"
Motor Horsepower	20 HP Normal
Maximum Round or Square Size Without Modification	5" Sq. or Round
Machine Stroke	2"
Machine, Net Weight	32,000#
Length x Width x Height	80½" x 52" x 116½"

See 'Buffalo' Machine Tools in action at the Machine Tool Exposition . . . Booth 551

ESTABLISHED 1877 "Buffalo" MEMBER N.M.T.B.A.

MACHINE TOOL DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

MMT-PE

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

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Make a Fast...Easy...Accurate Selection of

and know your size, shape, and grade are

The Allegheny Ludlum Tool Steel

STEELECTOR

- every type needed for 96% of all tool steel applications
- easy selection of the proper tool steel based on its individual characteristics
- stock shipment of grade and size assured at selection time

the Proper Tool Steel for any Application

Available with the A-L Steelector Program

easy answer to an old problem

Starting right now, the common problem of selecting the right tool steel for any job can become a thing of the past. With A-L's new STEELECTOR Program, you can make a *first time choice* of the proper grade for any application . . . and make it FAST, almost at a glance.

eliminates guesswork

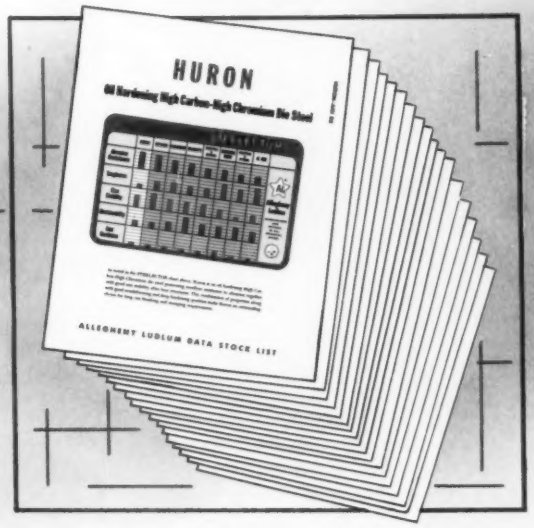
The STEELECTOR is ACCURATE, eliminating guesswork, trial runs, and expensive mistakes. And best of all, the STEELECTOR gives you a choice of tool steels that are AVAILABLE . . . in stock, right now! And they'll *stay* available . . . with a new, increased stocking program. STEELECTOR Grades are stocked according to a study of today's needs and will be reviewed periodically to fit changing requirements.

here's how it works

In the new program, a STEELECTOR Card covering each group of steels (Tool Room, Hot Work, and High Speed Grades) will help you select one particular grade as the best for your application. The STEELECTOR presents five basic tool steel properties—Abrasion Resistance—Toughness—Size Stability—Machinability—Red Hardness—as bar graphs, with the length of the bar showing the extent of each property in every STEELECTOR Grade. Find the properties most important to you and, by inspection, pick the grade with the characteristics you need.

availability assured

There is a separate Data Stock List for each STEELECTOR Grade, showing its complete range of warehouse stocks, as well as technical



data and basic application information. So, you can be sure the grade, size, and shape of your choice is in stock.

quality assured

And you can count on Allegheny Ludlum quality in every STEELECTOR Grade. They are selected from the complete line of A-L Tool Steel and made under the rigid quality control standards of all A-L products.

details available

It's all explained in the colorful A-L Tool Steel STEELECTOR Booklet, which includes STEELECTORS for the Tool Room Grades, Hot Work Grades, and High Speed Grades, and explains the Data Stock Lists for every STEELECTOR Grade. Ask your Allegheny Ludlum Sales Representative for your copy, or write: Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept. Ins. 7.

STEELECTOR
PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

AL

WHY NICE . . .

NICE offers Product Designers . . .

. . . a varied line of precision standard bearings, plus the ability to design and engineer "specials," with facilities and "know-how" backed by more than a half century of exclusive ball bearing experience. As "specialists in specials," experienced NICE engineers take advantage of every design opportunity to reduce costs without sacrifice of quality and to improve product performance and appearance.

Of special interest now are the advantages NICE can offer through the use of the revolutionary new UNIBAL Ball Bearing. Unique in design and patented method of manufacture, this unground bearing of superior quality is being used successfully in many precision bearing applications heretofore requiring the use of conventional precision ground bearings.

NICE engineering help is available to Product Designers, whenever needed, through the factory engineering department or qualified field representatives.

NICE

NICE BALL BEARING COMPANY
DIVISION OF CHANNING CORPORATION
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Standard Thread Plug and Ring Gages are Stock Items at Pipe Machinery

At Pipe Machinery, where prompt service is a basic precept, we maintain an extensive stock of standard thread plug and ring gages in a complete range of sizes through 1½". Minutes after we receive your order, your gages can be taken from a storeroom drawer, assembled, packaged, stamped and in the mail bag ready for shipment. For more complete information on the American Standard, NEF, Unified and pipe size gages we have available for immediate delivery, write us on your company letterhead today.

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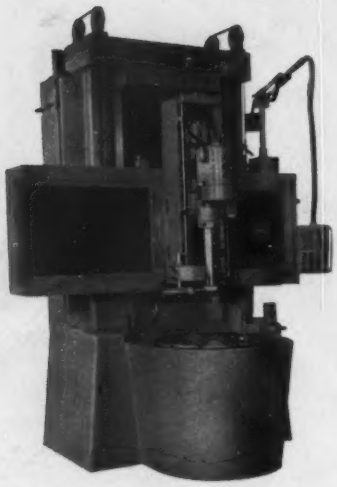
Vertical Universal Grinders



model 3-TR
52" swing

Springfield vertical universal grinders are among the most versatile tools you can use for *both* production and toolroom work. Head is easily positioned to grind ODs, IDs, surfaces, offsets and undercuts in *any* combination, generally with one chucking. Work may be regular or irregular in shape, up to 48" high with up to 52" swing on standard machines. Weight of workpiece is no problem because gravity works for you in vertical grinding – helps achieve extreme micro-inch finish and concentricity.

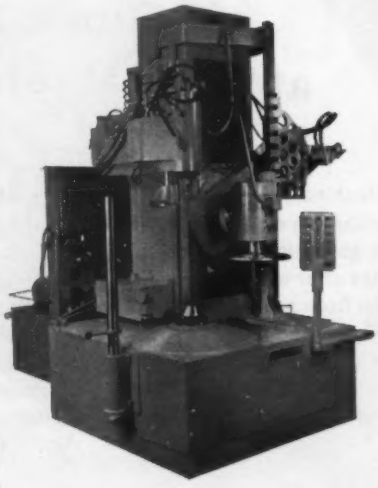
A typical example of a Springfield's remarkable precision is its ability to grind taper valve plugs and seats with one angle setting of the head—and get 95% blue or better on a taper gage with surface finish smoother than 30 RMS.

For high production, sometimes involving automatic loading, cycling, size control and unloading, Springfield builds special vertical grinding machines. Most of these can be reset when part changes occur. Another area in which Springfield has pioneered is in vertical contour grinding machines that handle missile parts.

If you would like to know more about Springfield vertical grinders, please write for Bulletin 197-G.

MMT·PE

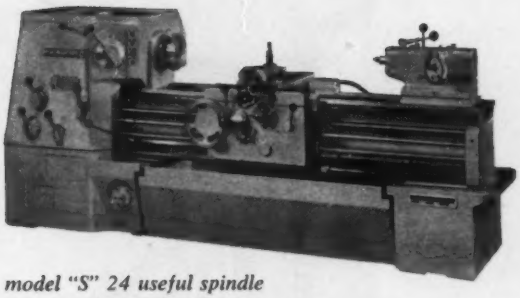
new developments coming!



vertical contour grinder

SPRINGFIELD

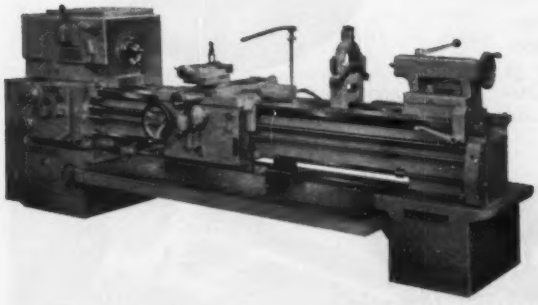
The Springfield Machine Tool Company
Springfield, Ohio



model "S" 24 useful spindle speeds, 66 feeds & threads
heavy duty 16"
medium duty 20"

MMT-PE

new developments coming!



model 280 16 useful spindle speeds, 60 feeds & threads
heavy duty 14", 16"
medium duty 20"

The Springfield Machine Tool Company
Springfield, Ohio

Engine & Toolroom Lathes

Springfield lathes have 10, 15 or 20 horsepower motors for heavy cuts, and have simple, practical features that keep the operator productive and keep the maintenance man away. Pressurized mist lubricates the headstock. Only four gears are in mesh for a given speed—the others run free. Clean, functional design and simplified controls promote pride of workmanship and minimum waste motion.

Ruggedness with precision has always been characteristic of Springfield lathes—because they are built to *one* standard of excellence. A Springfield engine lathe meets the accuracy standards set up for toolroom lathes —without *any* cost penalty.

Whenever you want maximum power and efficiency, and the cost designed out by designing simplicity in, consider a Springfield lathe. A full range of attachments is available—hydraulic contouring and reproducing, plain and universal relieving, taper, etc.

If you would like to know more about Springfield lathes, please write for Bulletins 190-G and 201-G.

SPRINGFIELD

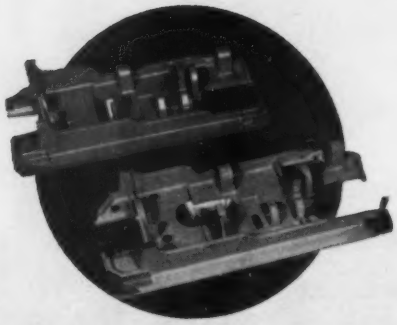
For more data circle this page number on card at back of book

Sub-contracting precision parts, assemblies and machines like these... is our business!

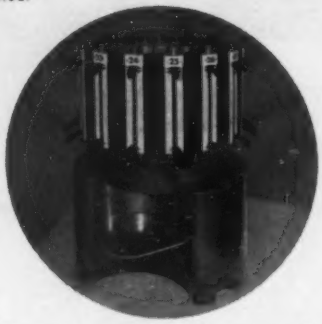
(but we want more of it)

We'd also like to prove to you what our completely integrated manufacturing facilities* can mean to you in terms of lower costs, faster delivery, and complete satisfaction.

TMW's facilities and 65 years' experience in high-precision (tolerances to tenths) manufacturing are available to you *now*, on a short or long-term basis. For details or a new Facilities File Folder, call or write today.



A TMW gray iron casting before and after precise machining, annealing and finishing operations were performed.



Paint dispenser was economically mass produced for a major manufacturer in TMW's modern shops.

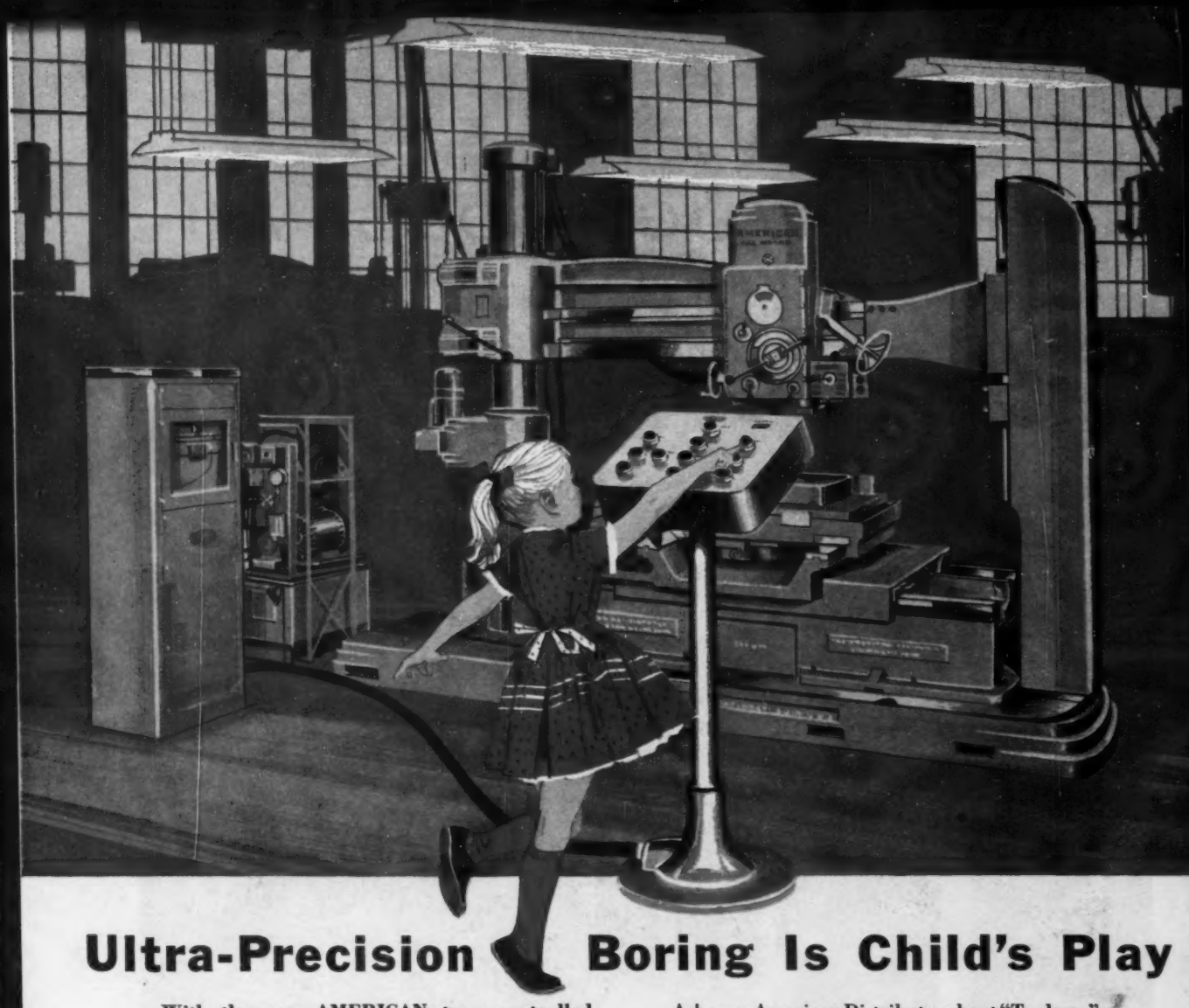
"The world's first and only automatic stud fastener" . . . (another example of TMW precision machining and assembly) carries a LIFETIME guarantee.

* Includes 1,000,000 sq. ft. of manufacturing space, 1200 *modern* machine tools, completely mechanized foundry (one of the world's largest), 3000 skilled craftsmen with a corps of top designers and engineers.

TEXTILE MACHINE WORKS

Contract Division • Reading, Pennsylvania

Jato units, used on the "Honest John" rocket to make it spin, are machined to ±.0002" tolerances and hydrostatically tested to meet strict government specifications.



Ultra-Precision Boring Is Child's Play

With the new AMERICAN tape controlled Positioning Table, *everybody* can bore to ±.00025″ without any possibility of error!

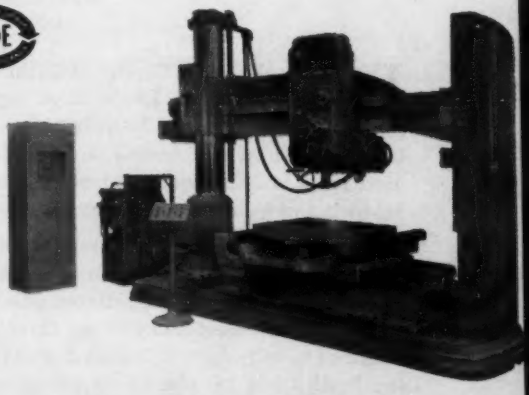
Low, low tooling costs and efficient production are child's play when you use the new American numerically controlled Positioning Table.

Designed by an American Tool Works Company/Sperry-Gyroscope team, your American ultra-precision Positioning Table is *rugged* . . . almost impervious to wear or failure. Electronic parts are protected by sealed, pressurized compartments. The Mylar tape is read by low pressure air . . . no steel fingers to tear the punched holes. Table and saddle ride on indestructible hardened and ground Timken graphite tool steel ways.

Used with the new American Hole Wizard Radial Drill, your American Positioning Table saves you up to 71% in tooling costs! Your production increases 400%! Your jig costs are entirely eliminated!

Ask your American Distributor about "Toolease", our leasing plan under which this American Positioning Table and American Hole Wizard Radial Drill combination can improve your production . . . while it pays for itself! Or, write Section 161 at the address below. Ask for Bulletins 700 and 801.

MMT-PE



THE AMERICAN TOOL WORKS COMPANY

PEARL STREET AT EGGLESTON AVENUE • CINCINNATI 2, OHIO

STEELWELD SHEAR
Serves TOUGH JOBS Well

Shearing a ¼" x 6'-0" x 20'-0" steel plate which rides on ball-bearing-capped stanchions. This is a Series 8D-12 Steelweld Pivoted-Blade Shear.

A part of an order of 120,000 gussets cut on the shear.

FOR several years a Steelweld Shear has been in operation at the Drake Steel Supply Co., Los Angeles, California. Most of the time it has been worked on a 16-hour-a-day schedule. It is used for a wide variety of shearing, mostly on 3/16-inch and ½-inch steel plate.

The machine has proven itself on all sorts of shearing jobs. A particularly tough one was the cutting of 120,000 small odd-shaped gusset plates. These were of three sizes and cut three to six at a time of ½-inch steel. The work jarred the shear terrifically, but because of its heavy construction, did not affect it in any way.

Considering the volume of work and hard service, the knives hold up very well. They need be turned only about once every six months.

Write for free copy of catalog No. 2011

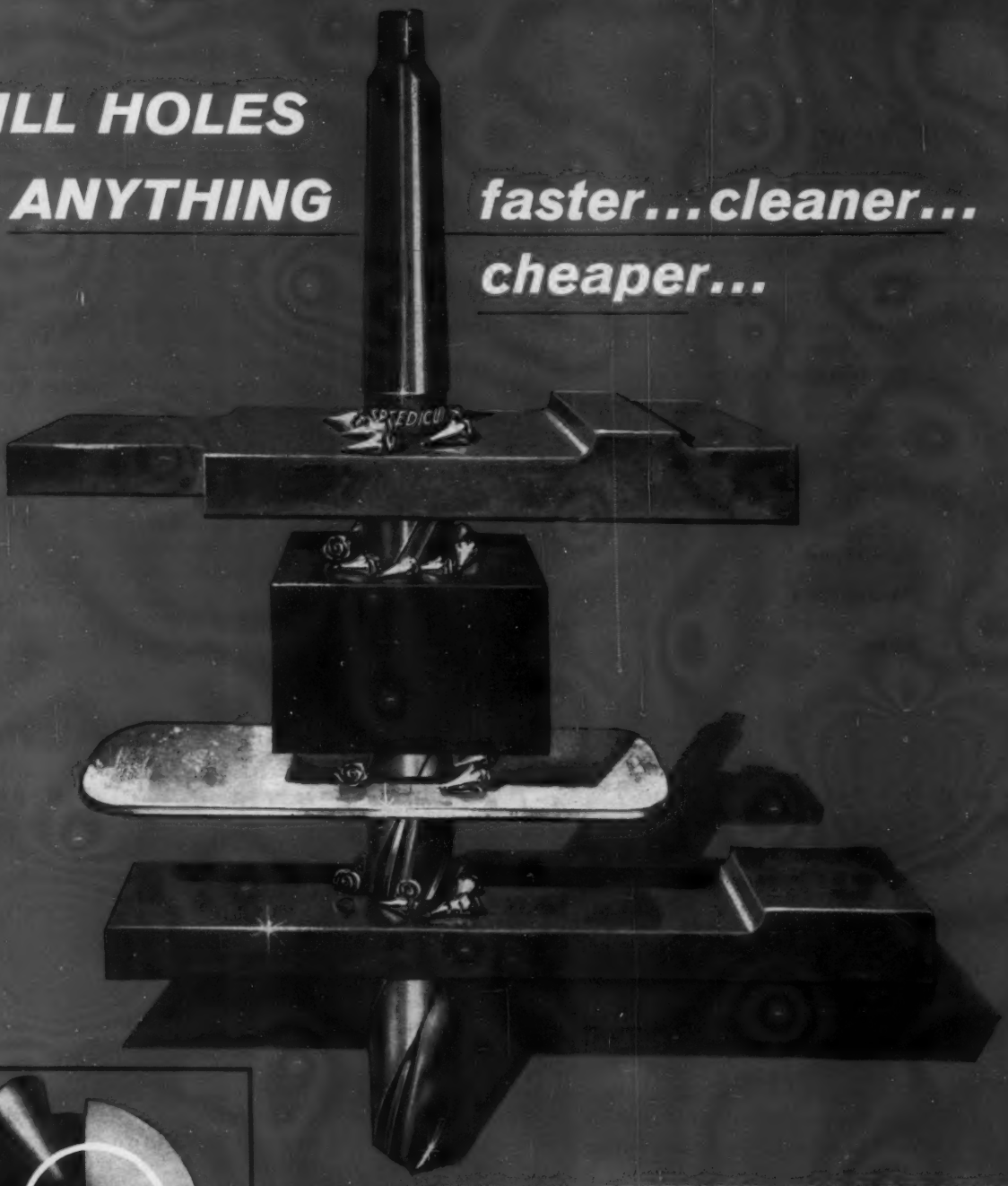
STEELWELD
Mechanical and Hydraulic
SHEARS PIVOTED BLADE

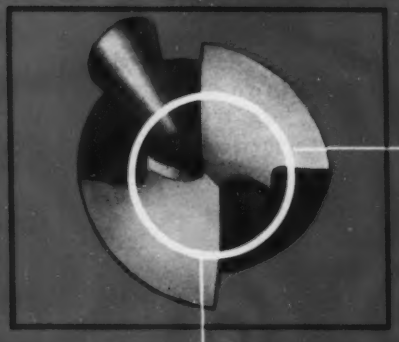
Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

THE CLEVELAND CRANE & ENGINEERING COMPANY • 5458 EAST 282nd STREET • WICKLIFFE, OHIO

DRILL HOLES IN ANYTHING

faster... cleaner... cheaper...





THE PATENTED RIB that cannot be duplicated

with the new SPEEDICUT "CHIPBREAKER",

the all-purpose drill that cuts cleaner holes faster in any machinable material while cutting production time and costs.

The secret is the patented rib* that permits 50% to 400% higher feed rates, deep hole drilling without withdrawal and more holes per regrind.

See a demonstration in your plant on your own equipment and type of work. Your local authorized SPEEDICUT "CHIPBREAKER" distributor will gladly arrange it. Write for brochure and name of distributor.

*U.S. Patent Number 2708355

SPECIFY *SPEEDICUT "CHIPBREAKER"*
SPEED WITH SAFETY

SPEEDICUT DIVISION, CHICAGO HEIGHTS STEEL CO. • CHICAGO HEIGHTS, ILL.

New, large capacity New Britain bar machines

If you feel you know New Britain bar machines like a book, a word of caution: There's a completely new book! New, basic design that removes limitations formerly inherent in bar machine construction. New power, new speed, completely new capability for imaginative tooling.

And new, large bar capacity. That is the important "new" we want to call to your particular attention here. You can apply New Britain standards of productivity to bar stock as large as 5⅛".

The new, big line of four-, six-, and eight-spindle models:

Model 450. Four spindles, 5⅛" maximum capacity, four independently operated radial cross slides.

Model 635. Six spindles, 3½" capacity, with independent radial cross slide in every position.

Model 826. Eight spindles, 2⅝" capacity. Six independently operated cross slides with the two lower slides exceptionally wide to provide elevating blocks for cross slide tooling in the number 3 and 8 positions.

Inexpensive, disc-type cams provide positive actuation of cross slides. Cross slide and end-working tools on all models are easily accessible. All models have positive spindle carrier lifting, locating and locking. New catalog material will give you further details on these machines. Your New Britain representative can show you how the increased profitability built into them can improve your competitive situation. Plan to see him soon.

THE NEW BRITAIN MACHINE COMPANY

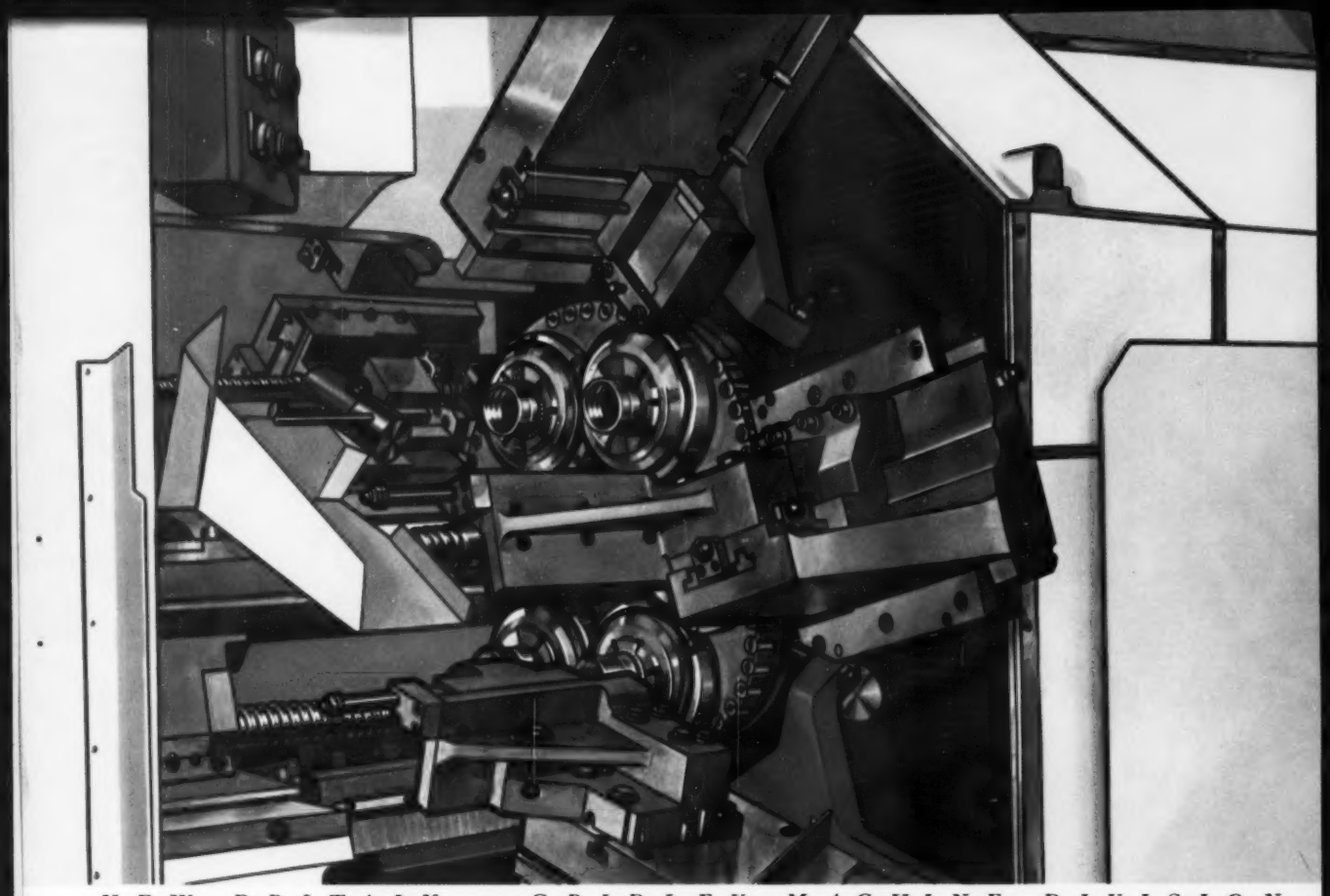
Capacity up to 15" on New Britain chuckers

We are going to take it for granted that *you* take New Britain chuckers for granted—as the leading make of multiple spindle automatics. Most people do. The big news then is that the profitability of these famous machine tools can now be applied to an increased range of work. The new New Britains are available with chucking capacities up to 15", which enables you to apply New Britain standards of speed, accuracy and versatility to larger work.

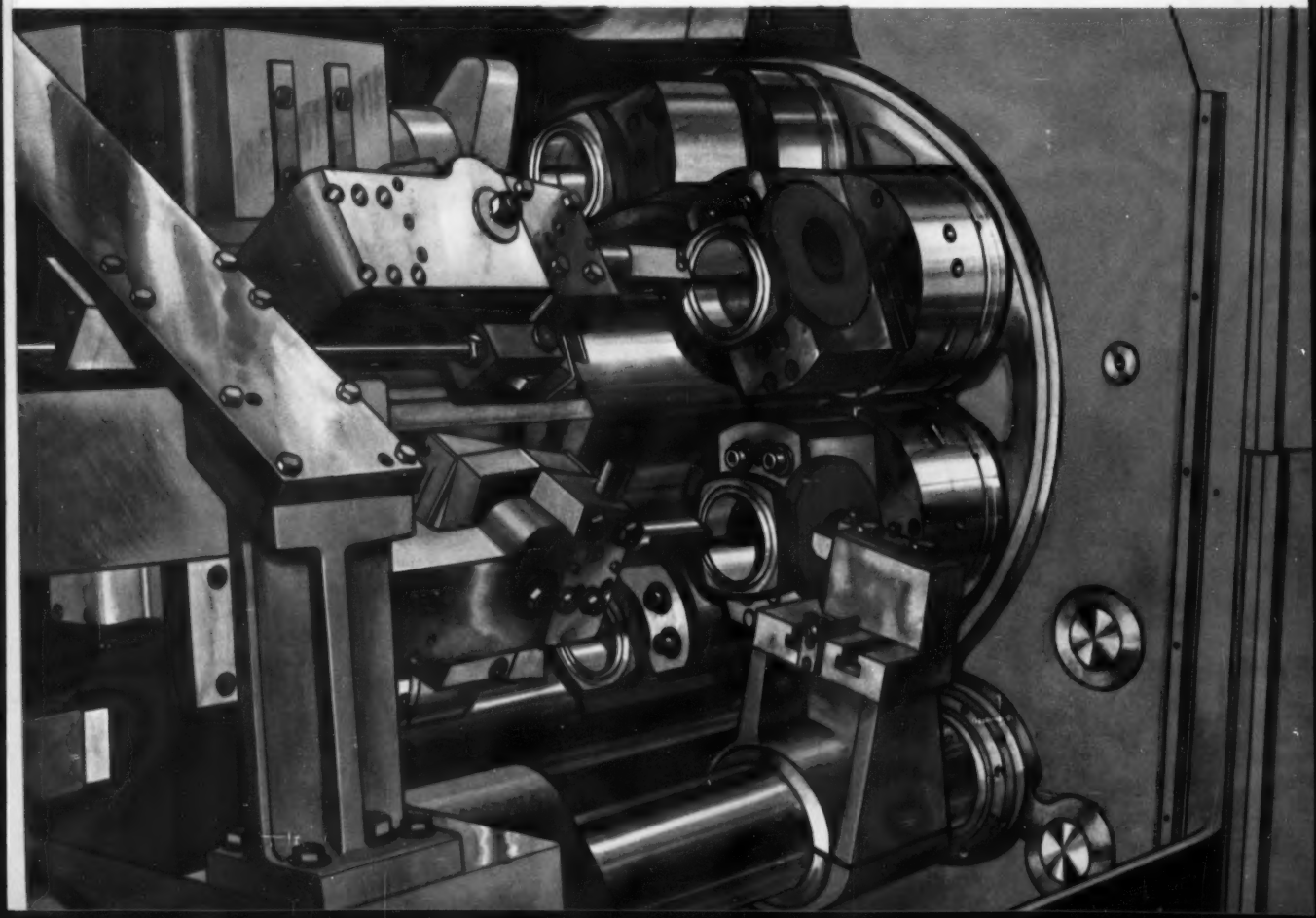
The 15" capacity applies to four-spindle models. Six-spindle machines will take pieces up to 12", and eight-spindle chuckers will handle up to 10".

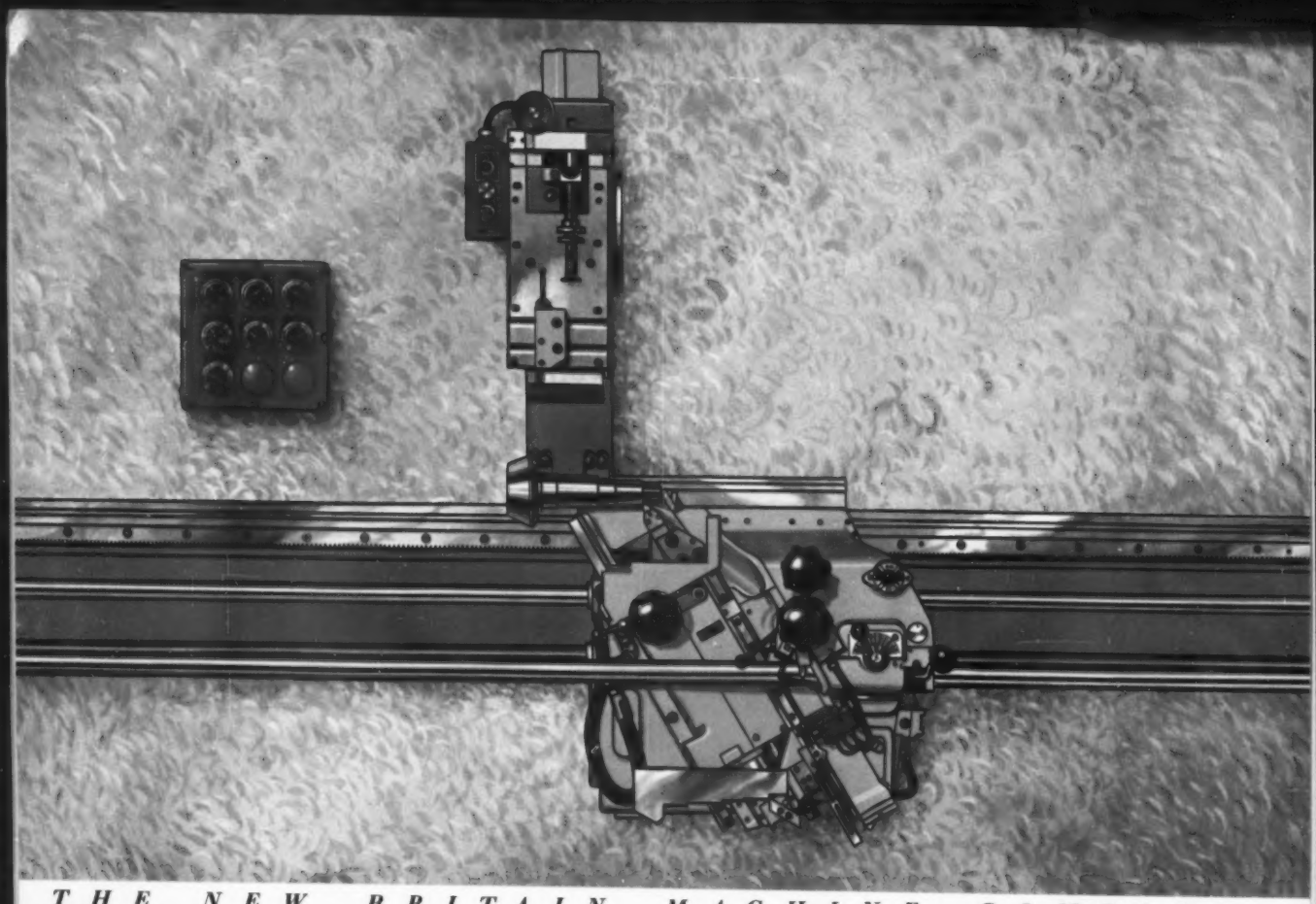
If you work with large castings and forgings, this might be the announcement of the decade, in terms of an investment that can't fail to be profitable. With equipment like this properly adapted to your particular requirements, nobody, anywhere, is going to trim you on cost per piece.

Call on your New Britain sales engineer for practical, specific information, of course. Meanwhile, we have just published a new catalog on these new large capacity chuckers, and we would be happy to mail your copy to you on request. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

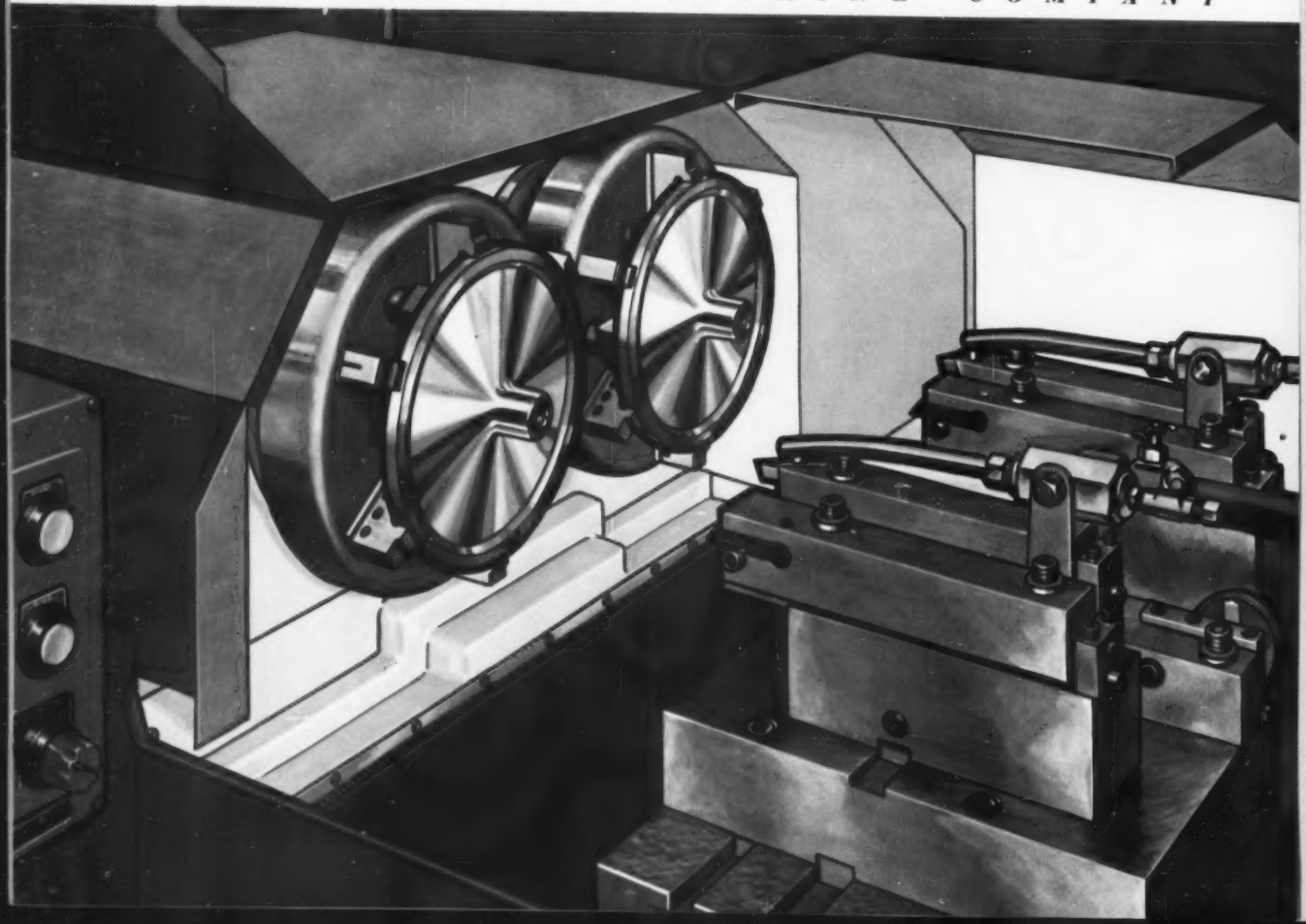


NEW BRITAIN - GRIDLEY MACHINE DIVISION





THE NEW BRITAIN MACHINE COMPANY



Fast, rugged New Britain +GF+ copy lathes

Right from the ground up the New Britain +GF+ is a machine conceived, designed and manufactured as a copying-contouring lathe. Not a standard lathe with copying attachment; not a factory-made "special" with the contouring feature built on components from other lathes; but a solidly based, ruggedly constructed, fast, powerful, accurate machine designed solely for the template-controlled, rapid production of between-centers or chucked work with external or internal contouring.

A million pieces or just a few, it's a machine you'll use on many different types of short-run jobs (just change the template and reset the controls), or on one long-run job (just replace the single-point tool when it wears).

The instantaneously accurate hydraulic copying mechanism is entirely enclosed within the compact carriage. All controls are within easy reach. The template is up front for easy adjustment. The chips fall free into the wide open base, can't clog or jam any part of the mechanism.

There are endless variations available within the New Britain +GF+ line. The standard model has applications anywhere on between-centers or chucked pieces. Other attachments and models are available to suit your particular requirements; infeed attachments, automatic loading, bar stock models, etc.

Don't buy any lathe or "special" for copy turning until you have investigated the New Britain +GF+ copy turning lathe. As a starter, may we send you the latest catalog?

NEW BRITAIN · GRIDLEY MACHINE DIVISION

Consistent accuracy to tenths at super speeds

Model 37 Precision Boring Machine is a machine with a mission, rather than an answer to everybody's metal turning problems. Its mission is contour boring and turning in applications where both extreme repetitive accuracy and high production are of paramount importance. If you have such a requirement, Model 37 is an unbeatable money-maker.

It is an inherently simple machine: simple to operate, with inspection limited to gauging any one dimension. Simple in operating principle, too, built around precision cams that operate without being affected by temperature fluctuation. From one to four high speed spindles can be mounted on a single machine.

We would be happy to discuss *any* production problem involving straight or contour boring and turning. We doubt that anyone equals New Britain's know-how in this area, and we have a wide variety of boring equipment, both vertical and horizontal and of very advanced design. No matter what your work, or production requirements, this is a very fine place to look for an answer. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

For more data circle this page number on card at back of book

Send for these free

Sheffield "BEST SELLERS"

Air Gaging
Precisionaire® Gaging Handbook, describes full Precisionaire instrument line; standard & special air gaging equipment. 48-pp. Catalog SPG-160.

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Sheffield-Cavitron Machine Tools; specifications, applications, tooling; illustrates principles and job applications. 16-pp. Catalog CAV-759.

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Covers Sheffield Models 101 and 103 for tool room and production. Shows variety of Crushtrue® applications, attachments. 12-pp. Catalog TFG11-59.

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Multiform Grinder
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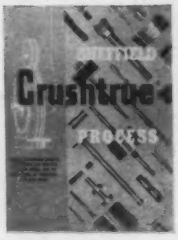

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Drop us a card or note with the numbers of the catalogs you want, or clip and mail this ad with the items checked

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firm _____

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The **SHEFFIELD** *Corporation* — *Dayton 1, Ohio*

A subsidiary of the Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems • Machine Tools • Contract Mfg.

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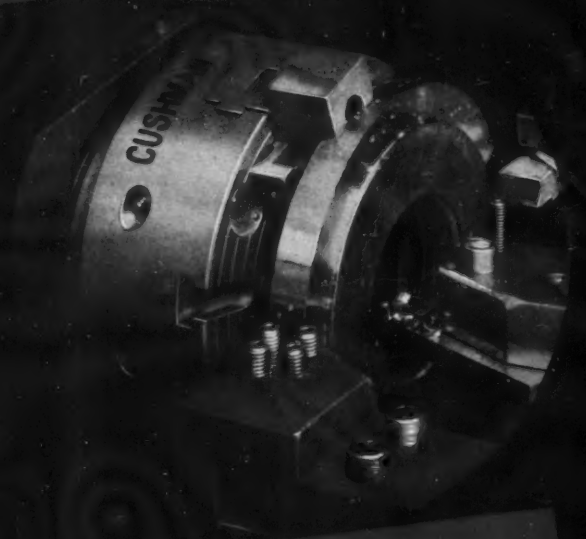
BULLETIN NO. PO 66D

CUSHMAN

George - This looks like the answer to our problem. Have their rep. come in.
H.R.S.

air operated CHUCKING EQUIPMENT



- INCREASES PRODUCTION
- LOWERS COSTS
- REDUCES FATIGUE
- IMPROVES QUALITY
- DECREASES FLOOR TO FLOOR TIME

PRODUCTION ENGINEERING SHOW
SEPT. 6-16 1960
NAVY PIER, CHICAGO
BOOTH NO. 126

THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONNECTICUT

"Will the weld be as strong as the cylinder?"

Marion Power Shovel asked this question when we recommended two-piece forgings (at considerable savings over the former one-piece forgings) for use as jack cylinders in their giant electric shovels. We answered "yes"... and tests show the weld metal has higher mechanical properties than the minimum physicals required for the cylinder.

BECAUSE THE HOLE *at the cylinder end is small, machining the sleeve before the head is welded on is lots easier and faster than machining the former one-piece forging. There's more room to work; the tool can get a good grip on the piece, hog out the metal, instead of pick it out. The savings are more than enough to offset the added welding cost.*

FOUR FORGED-AND-WELDED *"equalizing" cylinders, like those above, are used to keep the upper frame of this Type 5761 Electric Shovel level during operation. Made by Marion Power Shovel, Marion, Ohio, this shovel's dipper has a 65 cu yd capacity.*

Forged from manganese-vanadium steel, this sleeve-and-head cylinder weighs 22,690 lb.

The sleeve itself is 9 ft, 10 in. long, with a body OD of 45 in. Flange OD is 48 in.; flange ID, 35¼ in. The wall is 5-in. thick. To produce it, we upset, punch, hollow-forge, double-normalize and temper. Then we finish-machine to size, including the weld bevel on the end of the sleeve.

We forge the head as a disc of 49 in. diameter, and 11-in. long. Then we finish-machine it to size (45-in. OD, 9¾-in. long), including the weld bevel, and treat it the same as the sleeve.

The two pieces are then assembled and welded. The cylinder receives a stress-relief anneal after welding, and the weld is radiographed to assure soundness. Excess weld on the OD and ID is then machined off.

If you have a forgings problem, Bethlehem is a good company to get in touch with. We think as hard about one-pound drop forgings, as we do about 200-ton press forgings. To start us thinking about your forging, call the Bethlehem sales office nearest you.

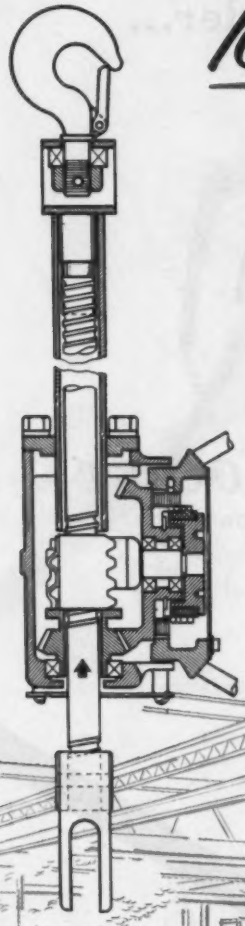
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

Steel — For strength ... economy ... versatility

BETHLEHEM STEEL

BETHLEHEM STEEL

NEW Whiting Ladle Handler Lifts 100 lbs for Every Pound of Effort!

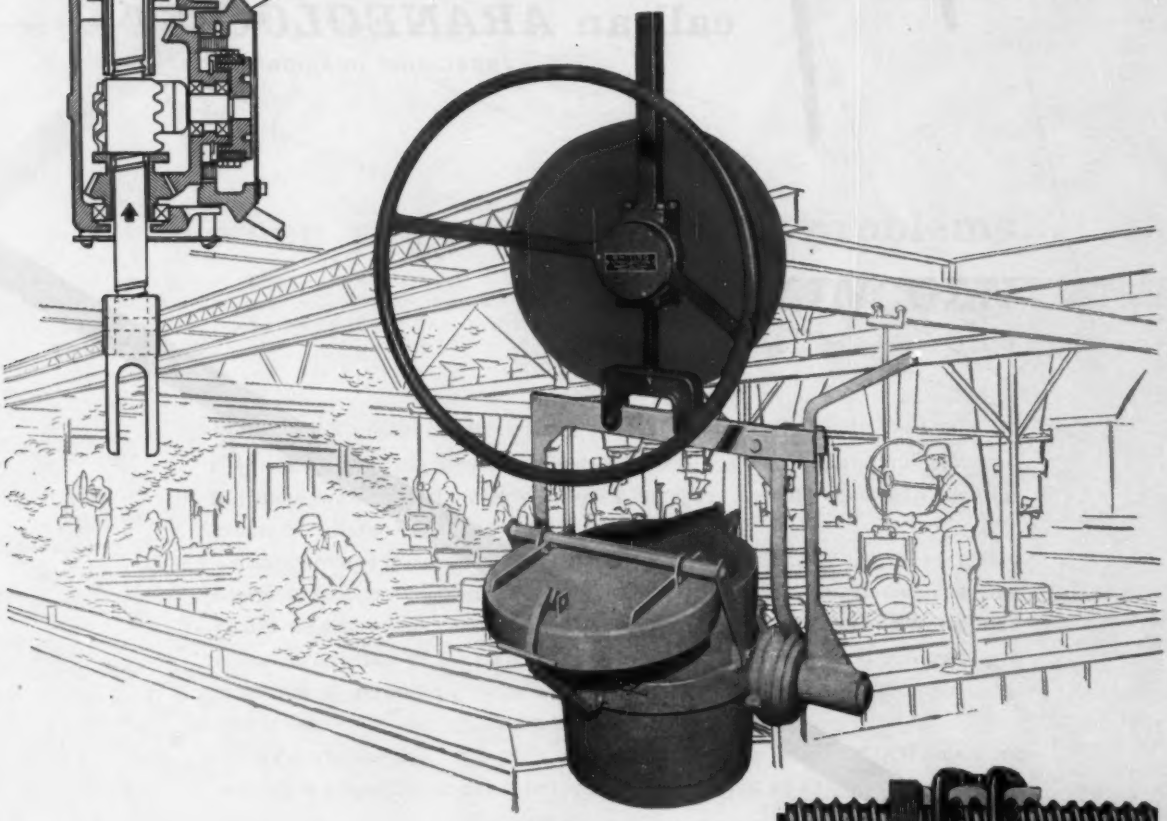


. . . made possible by the Saginaw b/b Screw!

The Whiting Corporation, heavy foundry equipment manufacturers, designed a ladle handler that lets the operator manually raise and lower a gross weight of over 2250 pounds with maximum ease and control. The Saginaw Ball Bearing Screw got the actuation job!

A turn of the handwheel on the new 'H-E' Ladle Handler transmits torque to the Saginaw Screw which converts *rotary* motion into *linear* motion with over *90% efficiency*. This, with a unique clutch-brake spring, helps the operator LIFT 100 POUNDS FOR EVERY POUND OF EFFORT, and maintain control at all times! The Saginaw Screw also provided savings in maintenance, wear, parts and weight.

The Saginaw Screw may be able to improve your product's performance and increase its sales acceptance. Write or telephone Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Michigan—*world's largest producers of b/b screws and splines.*



Actuation To Fit Your Individual Requirements

Have been built as small as 3/16 in. B.C.D. and 3/4 in. long, as large as 6 in. B.C.D. and 40 ft. long. Larger sizes can be built to your order.

Saginaw b/b Ball Bearing Screw

WORLD'S MOST EFFICIENT ACTUATION DEVICE

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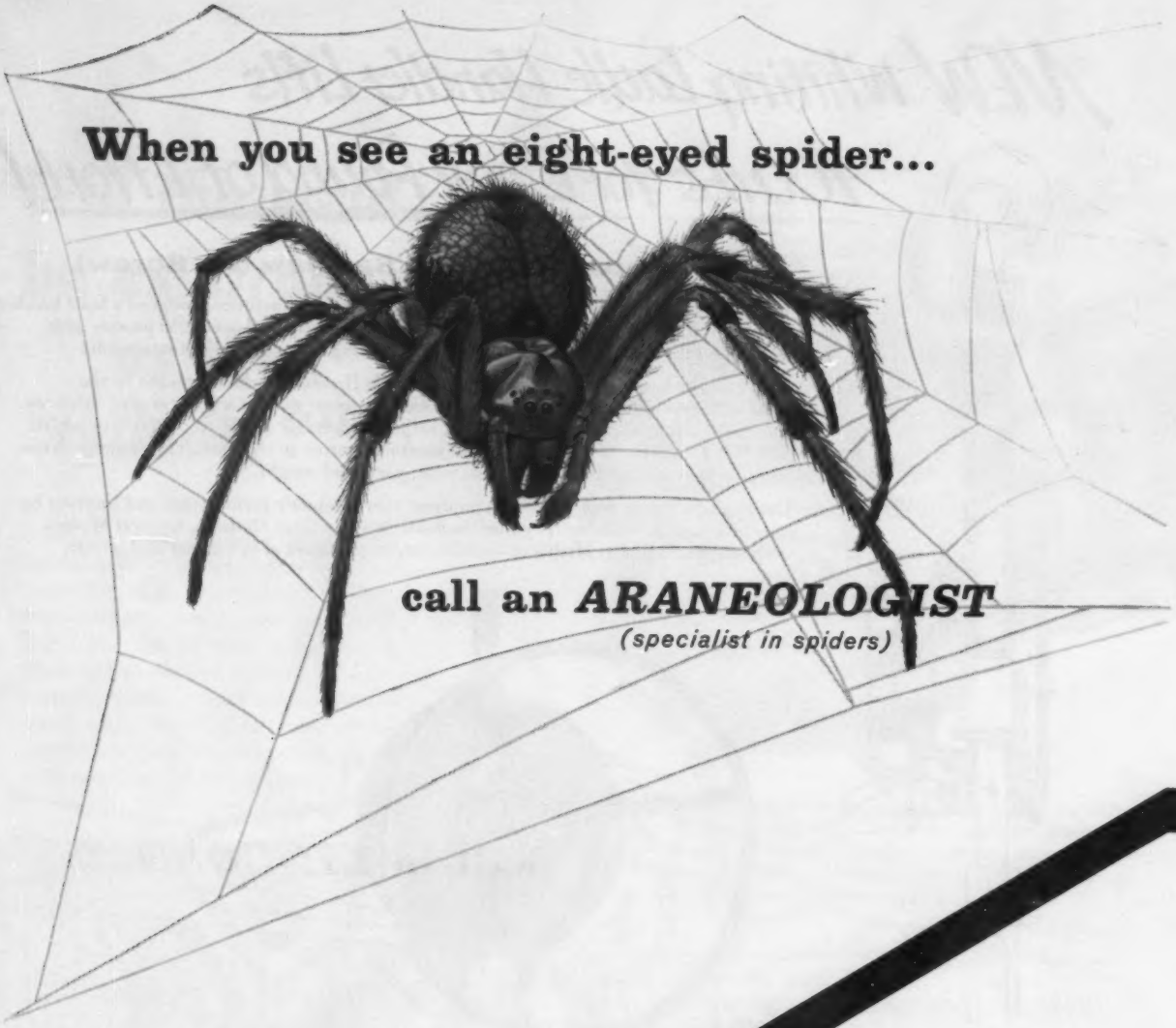
When you see an eight-eyed spider...
call an ARANEOLOGIST
(specialist in spiders)

when you've got welding problems...
call in *LINCOLN*

(specialists in arc welding)

A SOUTHERN sheet metal fabricator had "burn-thru" in the welds. The LINCOLN Field Engineer recommended Fleetweld 37 and licked the "burn-thru" problem. But more important, the new electrodes increased welding speeds to such an extent that overall costs dropped a third.

And right there is a good reason for doing business with LINCOLN. Ideas to whip knotty production problems come naturally to the Field Engineers. They are factory-trained where they—and everyone else—gets paid according to his individual contribution to the company's goal—superior products and service to you at continually decreasing costs. So, while he knows welding, he also understands how to relate it to your total manufacturing operation.

That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

THE LINCOLN ELECTRIC COMPANY
Dept. 2220 • Cleveland 17, Ohio

LINCOLN ELECTRODES

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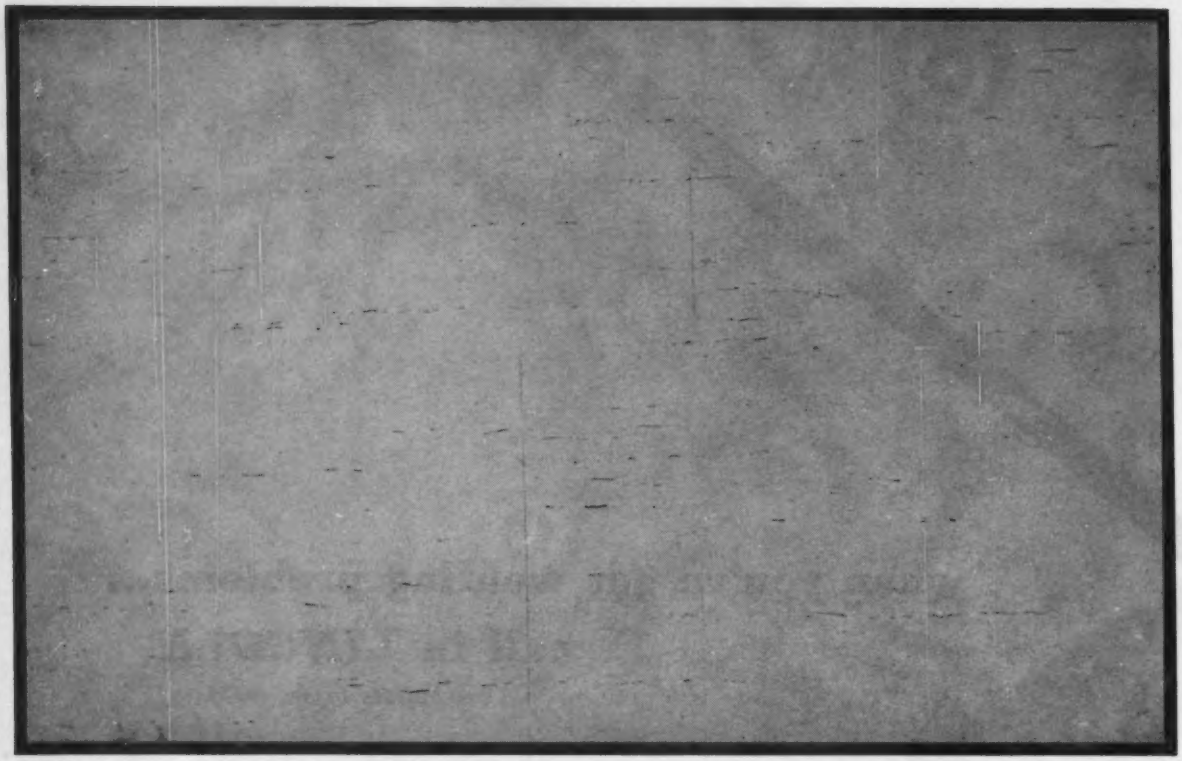
Why this steel costs less to machine...



100 X

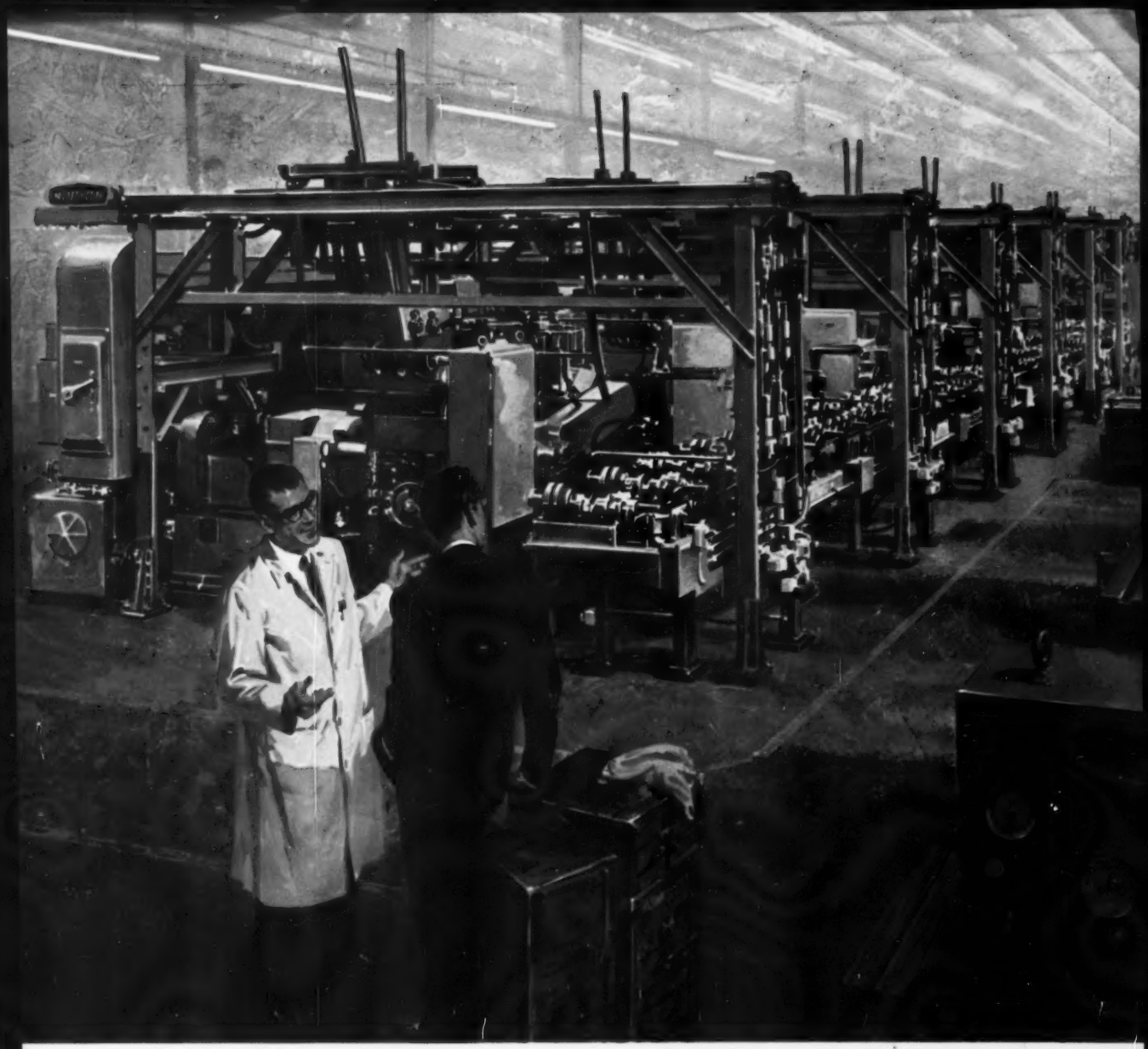
YOU'RE looking at a photomicrograph of Timken® steel that has been resulphurized to give better machinability. Those sulphides you see in the picture interrupt the chip flow, giving shorter chips and faster machine speeds.

And you get this better machinability without any sacrifice of surface quality or mechanical properties when you buy Timken resulphurized steels. Small amounts of carefully prepared sulphides are added to the molten steel under exact conditions of time and temperature. The result: Tubes or bars with good surface quality, good physical properties, and substantially improved machinability without the disadvantages sometimes found in free-machining steels. And when you buy Timken fine alloy steel, you're assured of uniformity from bar to bar, heat to heat, and order to order.

If you're looking for a way to reduce machining costs on parts made from seamless tubing, bar stock, or forgings, call your nearest Timken Company sales office. Timken resulphurized steels are available in most grades of alloy steel. ***When you buy Timken steel you get . . .*** *1) Quality that's uniform from heat to heat, bar to bar, order to order. 2) Service from the experts in specialty steels. 3) Over 40 years experience in solving tough steel problems.* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

TIMKEN® *Fine Alloy* STEEL

TIMKEN ALLOY STEEL AND SEAMLESS STEEL TUBING ARE AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES



And now . . .
Norton Automatic Transfer Machines Multiply the "Touch of Gold"

The new Norton Transfer Type Crankshaft Grinder is actually many cylindrical grinders in one . . . in which adjusting, controlling, gaging, transferring and all other manual operations have become fully automatic! Once again the Norton "Touch of Gold" aids in mass-producing . . . swiftly, accurately, economically.

To the development of grinding machines — ranging from the smallest and simplest to the largest and most complicated — Norton brings the longest and broadest experience. See your Norton Man about putting this experience to work for you.

NORTON COMPANY, Machine Tool Division, Worcester 6, Mass.

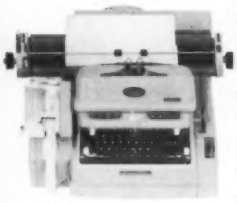
NORTON
MACHINE TOOLS

75 years of . . . Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes
MACHINE TOOL DIVISION: Grinding and Lapping Machines — **G & E DIVISION:** Shapers • Gear Cutting Machines • Gear Induction Hardeners

Is punched tape really the best input medium for numerical control?

(3 out of 4 machine tool makers say yes!)



Although 8-channel punched paper tape is only one of several numerical control input media, it is fast becoming the standard. Better than three-quarters of all builders of numerically-controlled machine tools now offer punched paper tape control. Why the swing to punched paper tape? There are three fundamental reasons:

1) Paper tape coding is visible, tangible. You can see it, touch it, and with practice even read it.
2) Paper tape is continuous. Unlike cards, it can't get out of order.
3) Paper tape is easy to program—preparation, verification, and reproduction of tapes are all handled on one inexpensive machine, the Friden Flexowriter® (illustrated).

For the machine tool buyer, standardization on paper tape means great savings. It's so much easier (and less expensive) when *one* input system can control *all* of the numerically-controlled machines in a given plant.

If you're thinking numerical control, you'll be way ahead to think *punched paper tape*.

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SALES, SERVICE AND INSTRUCTION THROUGHOUT THE U. S. AND THE WORLD

Friden Creates A New World for Business®

Friden

NEW!
RED RING PRECISION GEAR HONER

Smaller

More Compact

Lower Cost

FULLY AUTOMATIC
SEMI-AUTOMATIC
MANUAL LOADING

Your choice of 4 Honing Methods

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

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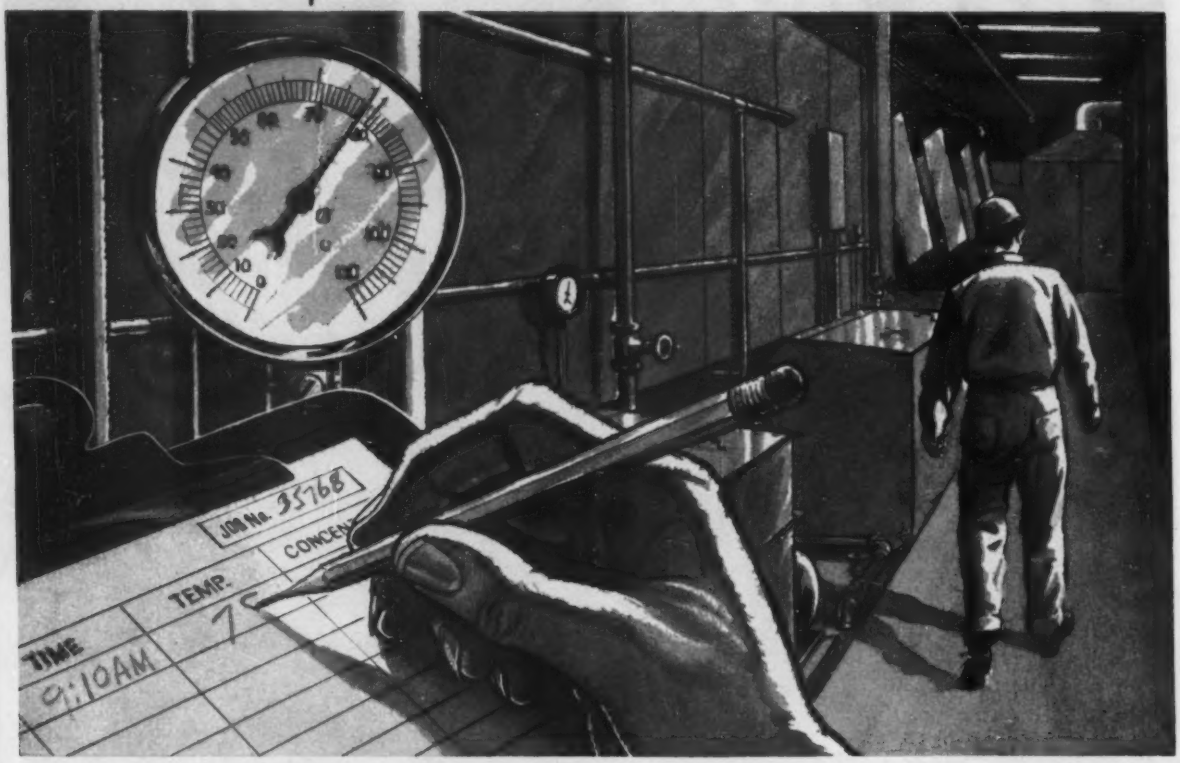
To get the most economical spray washing

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS



Oakite ROOM-TEMP cleaner cuts solution heating costs

That's right! Oakite Room-Temp cleaner gives good cleaning results at 70° to 100°F.—the temperature range you find in most industrial cleaning areas. This cleaning efficiency can save you money on steam normally required for heating of cleaning solutions.

Designed primarily for spray-wash machines, Room-Temp cleaner is non-foaming . . . good for steel, iron, brass, aluminum . . . has no odor . . . requires no ventilation.

Room-Temp cleaner provides top rust protection for in-process parts, too. It dries to a thin film that stops corrosion from attacking iron and steel for more than 300 hours at 90% humidity, 100°F.

ASK THE OAKITE MAN to tell you more . . . or to help you choose from the complete Oakite line a spray-washing material that offers most economy for the parts you're processing. Or, write for application data sheet B-6972. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

over 50 Est. 1909 SCIENCE

years' leadership in industrial cleaning

For more data circle this page number on card at back of book

UNIVERSAL BORING CHUCK is heavy and rigid for all types of rough boring without chatter yet accuracy of adjustment adapts it equally well to finish boring. Time-tested Universal Collet nose holds boring tool much more rigidly and securely than set screws while precision and extreme accuracy of feed-adjustment are obtained by an anti-backlash arrangement of feed screw and large dial.

UNIVERSAL
COLLET CHUCKS

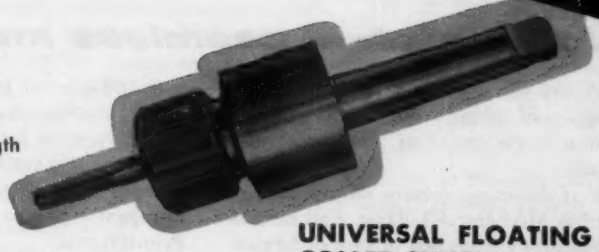
combine maximum holding power and minimum run out with simplicity of design and low price

The basic collet principle is the same in all Universal chucks. Tools gripped in these chucks withstand a maximum thrust and radial load because the collet grips on a continuous surface its full length and positively locks the tool. Write today for new catalog showing the complete line of Universal collets and chucks.

UNIVERSAL RELEASING TAP CHUCK has same basic collet principle featured in all Universal Collet Chucks. Screws or sleeves are not needed and collets are interchangeable with other Universal chucks. Simple, compact design has no springs, cams or pawls to break or wear. Can be used for either right or left hand tapping without adjustment.

HIGH PRESSURE REVOLVING COOLANT TRANSFER CHUCK has standard Universal Collet Chuck nose and a variety of shank sizes can be held by simply changing collets. Minimum overhang is made possible by the single face seal design. Back pressure principle of this design prevents "brake" action thus lowering torque on spindles. Chucks for higher speed and pressures than standard plus a variety of mountings are also available.

210



UNIVERSAL FLOATING COLLET CHUCK for horizontal or vertical operation is positively protected against destructive action of coolant by a seal which prevents entrance of compounds into interior of assembly. Frictionless ball bearing flat springs are adjustable to counter-balance weight of the tool.

UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 2, MICHIGAN

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TO MINIMIZE PRODUCTION COSTS SPECIFY

B&W *Job-Matched seamless mechanical tubing*

Only through B&W can you get . . .

- such a wide selection of tubing from which to choose
- unbiased assistance in the choice of the type of tube for a given application

Service is only one of the many reasons why it pays to specify B&W Seamless Mechanical Tubing. And remember matching tubes to jobs assures you of ease of fabrication and a better product at optimum low unit cost. For more information call your local B&W District Sales Office or write for Bulletin TB-361. B&W Mechanical Tubing is also available through a nationwide network of independent Steel Service Centers. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

Steel

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9048-SM2

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

A ROOMFUL of THOMPSON GRINDERS

This is the eighth Thompson grinder recently installed at Jessop which grinds plates and sheets up to 60" × 96" in size.

Jessop precision ground flat stock which is used in gages, dies, verniers and other exacting products.

Pictured above are 4 Thompson Grinders in the Specialties Division of Jessop Steel Company, Washington, Pennsylvania. There are 4 more Thompsons which are not shown in the above photo. All these Thompson machines are grinding to the extremely accurate tolerances and fine RMS finishes that distinguish Jessop's precision ground flat stock.

There are excellent reasons for using 8 Thompsons on this essential production. Mr. Joseph Manfredi, who is responsible for the quality and production of this famous ground flat stock, says, **"We have recently installed our eighth Thompson grinder in this division. We have proven the top performance of these rugged machines for many years. They give us the extreme accuracy and precision we demand—day after day with a minimum of maintenance."**

You may not need 8 Thompson grinders in your operations but it will pay you well to investigate what just one Thompson machine can do toward saving time, improving your products and cutting your costs of manufacture.

Your inquiries are invited.

MMT·PE

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

"Keep Thompson in mind for that daily grind"

Thompson SURFACE GRINDERS

For more data circle this page number on card at back of book

Machine tools using VICKERS hydraulics maintain precision tolerances on Ford Falcon engines

At Ford Motor Company's Lima, Ohio, plant you'll find the newest techniques and finest equipment being used to produce the six-cylinder, high efficiency, overhead valve engine developed specifically for the new Falcon. And, coincidentally, you'll find many of the machine tool builders have equipped their modern machines with Vickers hydraulics.

Modern production equipment and Vickers hydraulics just go together naturally. Machine builders and users know these pumps, motors and control elements can't be beat in design features and quality of manufacture.

You get "extra" planning help from sales engineers who are hydraulic specialists responsible for the products of a single manufacturer. Skilled technicians who are always near at hand assure better service, too.

Get more details on the most complete line of modern industrial hydraulic equipment available anywhere by writing for Bulletin 5001C.

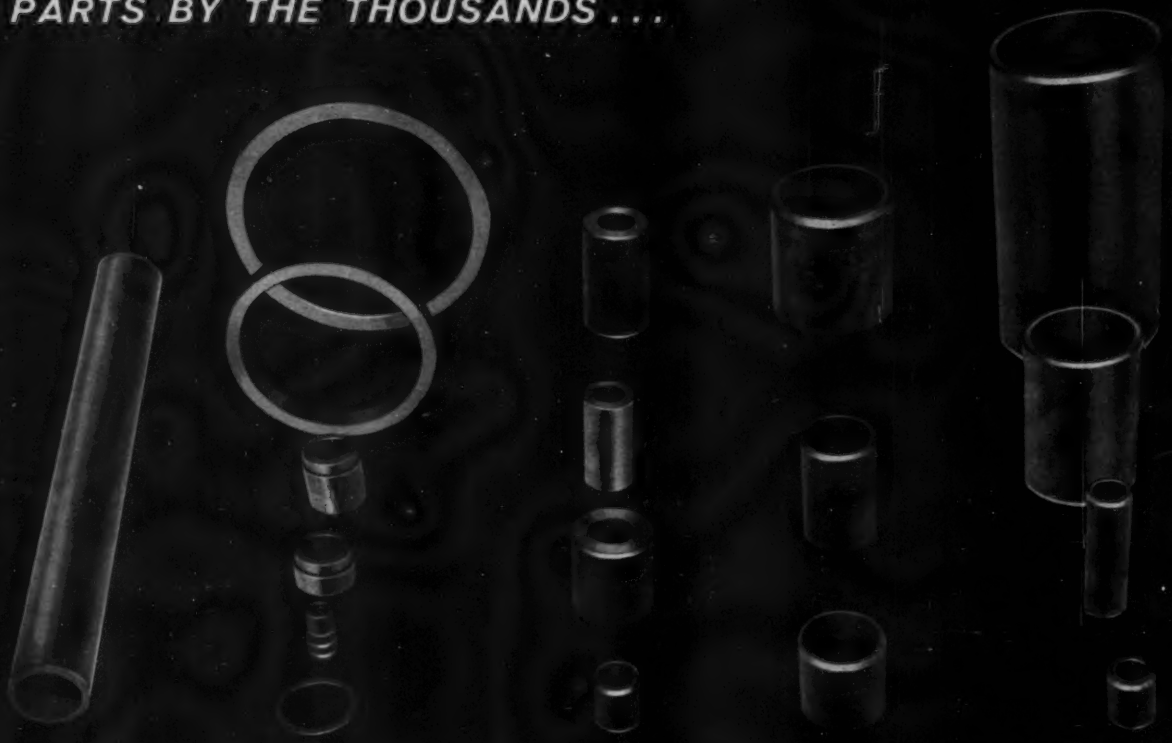
VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
DETROIT 32, MICHIGAN

8608

Machine tool builders using Vickers components at the Falcon engine plant

Apex Corporation
Bilt-Rite Tool Co.
Buhr Machine Tool Co.
Con-Tec Division Centri-Spray Corp.
Colonial Broach & Machine Co.
The Cross Co.
Ex-Cell-O Corporation
Greenlee Bros. & Co.
Holcroft & Company
Industrial Metal Products Corp.
The Ingersoll Milling Mach. Co.
Kent-Owens Machine Company
H. R. Krueger & Co.
F. Jos. Lamb Co.
Landis Tool Company
LaSalle Machine Tool, Inc.
The R. K. LeBlond Mach. Tool Co.
Leland Detroit Mfg. Co.
Micromatic Hone Corporation
Morris Machine Tool Co.
The Motch & Merryweather Machine Co.
Snyder Corp.
Sundstrand Machine Tool Division of Sundstrand Corp.
Surface Combustion Division of Midland-Ross Corp.
Toledo Division The Ohio Crankshaft Co.
Turner Brothers
Wilson Automation Co.

PARTS BY THE THOUSANDS . . .



Left to right: Plastic tubing, rings and formed spacers, coupling blanks, heavy pipe nipple blanks, standard pipe nipple blanks.

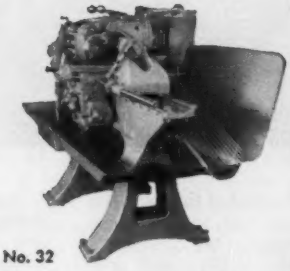
Formed . . . Chamfered . . . Cut-Off on BARDONS & OLIVER Cutting-Off Lathes

Superior Pipe Specialties Co., Chicago, reports a *ten year* profit success using Bardons & Oliver Cutting-Off Lathes.

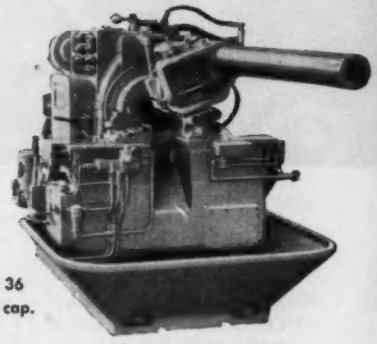
The firm produces parts for their hydraulic equipment plus a wide variety of products on a jobbing basis.

Says Mr. Youhn, Factory Superintendent: "Bardons & Oliver Cutting-Off Lathes are the *only* machines of this type that will stand up under years of hard use. We are completely satisfied with them in every respect."

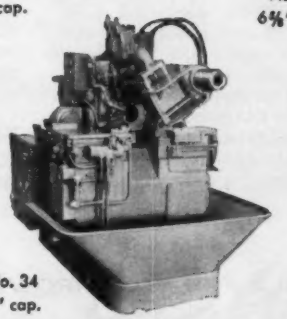
As the above photograph suggests, "versatility" is the name for these Bardons & Olivers. They're unexcelled for forming, chamfering and cutting-off tubular or solid bar stock. You realize extra profits by using these outstandingly rugged machines in your plant. Available in collet capacities from 2 to 16 inches, with automatic loading and unloading equipment if desired.
Bardons & Oliver, Inc., 1133 West 9th Street, Cleveland 13, Ohio.



No. 32
2" cap.



No. 36
6⅛" cap.



No. 34
4" cap.

OPERATING DATA FROM SUPERIOR

Typical hourly production
- No. 32 — 4000 - ½" pipe nipples chamfered & cut-off.
- No. 34 — 1082 - 2" pipe nipples chamfered & cut-off.
- No. 36 — 240 - 5" pipe nipples chamfered & cut-off.

Tolerances held on lengths: ±.002"

Average set-up time: 20 minutes

Tooling
High speed steel, carbide or roller cutter, depending on finish desired, material, operations performed and lot size.

Operators Required
2 men operate 3 machines, including setup, loading, and unloading (With automatic handling equipment 1 man can run 3 machines).

BARDONS & OLIVER

Manufacturers of Turret Lathes and Cutting-Off Lathes

HOUR OF DECISION

After hours? — sure You're not surprised at that because you know it's when he (and probably you, too) concentrates on the problems which are vital to his company's continued successful growth. The day is filled with production crises, maintenance problems, personnel questions, and committee meetings. It's only now that he can really study the facts and decide what's best.

Right now he's reviewing his machine tool inventory. He's amazed at how old some of his equipment is getting to be. It seems only yesterday that he signed the purchase order for it to increase his capacity for World War II. But that was 1943, seventeen years ago! No wonder maintenance is getting high and efficiency is dropping off.

We've got a suggestion for this man (and for you, too). Attend THE MACHINE TOOL EXPOSITION — 1960 and see for yourself why Modern Machine Tools = Production Efficiency. This exhibit, the first since 1955, is sponsored by The National Machine Tool Builders' Association* and will contain eleven acres of the U.S.A.'s newest machine tools under power, cutting and forming metal to demonstrate 1001 ways to lower production costs. Can you afford to stay home?

You're also invited to the PRODUCTION ENGINEERING SHOW on the Navy Pier.

No extra registration needed.

*The N.M.T.B.A. represents 90% of the U.S.A. machine tool industry.

FORMULA FOR TOMORROW

MODERN MACHINE TOOLS — MMT=PE — PRODUCTION EFFICIENCY

International Amphitheatre
Chicago, Illinois
Sept. 6-16

THE MACHINE TOOL EXPOSITION – 1960

For information write to

NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

2139 Wisconsin Avenue, N.W. • Washington, D. C.

Magnetic Holding Practical on Lathes . . .

focused flux from ceramic magnets mean maximum power

The new Walker Permanent Magnetic Ceramax Rotary Chuck designed especially for lathe as well as grinding applications has one unique advantage over other types of magnetic chucks — it actually prevents magnetization of the machine, the tools and the work — the work piece and tool remain chip free. In addition — powerful permanent Ceramic magnets, providing positive holding with three times the coersive force of ordinary alnico magnets, make possible safe, rugged lathe *turning*.

Other features:

• Variable holding for easy work positioning • Rotationally balanced • All steel work surface • Special "Lock" feature prevents sudden demagnetization while chuck is rotating • No electrical accessories • Sizes — Diameters 4" x 12"

Hi Power Standard Electric Chucks

Walker Hi-Power Standard Electric Chucks are used with all general grinding, and feature heavy cast steel construction, hi-magnetic efficiency, dimensional stability. These famed chucks have long been recognized as the most dependable in electro-magnetic holding.

for NEW FREE catalog

write to: O.S. Walker Co., Inc.

ROCKDALE ST. • WORCESTER 6, MASS.

Original Designers and Builders of Magnetic Chucks

For more data circle this page number on card at back of book

NATCO
B
A

From one pushbutton station, the line operates as a single unit, but each machining element has its own controls for independent operation.

A "medium" production transfer line like this can be built by adding as little as 12½ per cent to the cost of the individual machines.

New Convertible Transfer Line Trims Costs of "Medium" Production

By linking four standard Natco multiple-spindle drilling machines with transfer devices, Caterpillar Tractor Co., Peoria, Ill., has substantially reduced the cost of drilling and reaming diesel cylinder blocks. The transfer line incorporates three standard Natco 2-way machines and one vertical C4B.

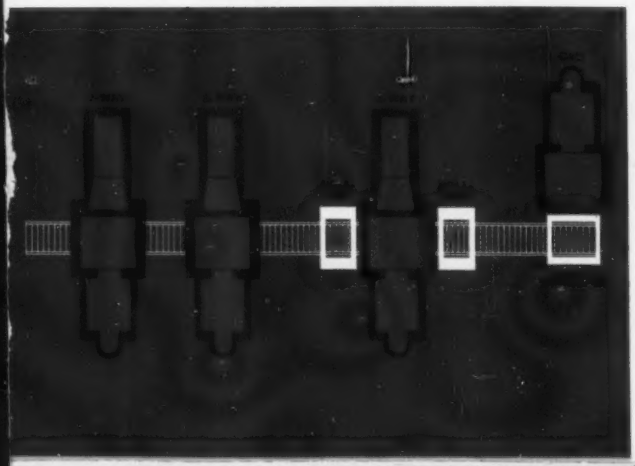
Each machining unit is self-contained with its own hydraulic and electrical system. Machine units can be interchanged or removed from the line for independent operation. Transfer links are standard Natco types.

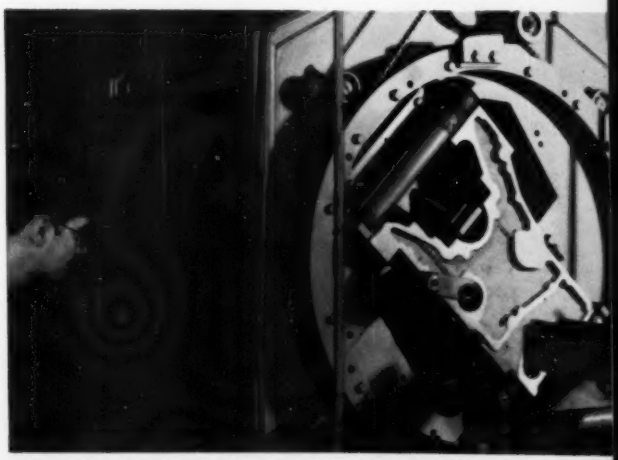
Take advantage of this new approach to "medium" volume production by calling your Natco representative. Write for bulletin No. 100.

NATCO

The National Automatic Tool Company, Inc., Richmond, Indiana

Rollover, shuttlebar, and walking beam transfer devices link the various machining units of this unusual line.





Rollover device repositions cylinder block. Other Natco transfer devices resolve the loading differences between machining units, providing both in-line and cross-line motion.

No Grinding... No Blade Resetting

NEW KENDEX* MILLING CUTTER USES THROW-AWAY INSERTS

With a heavy cutter body . . . and more than ⅝-inch of solid Kennametal* backing up each insert . . . new Kendex Milling Cutters are built for the rugged service necessary for fast metal removal. The one-piece cutter body is made of heat treated steel. A 15-degree corner angle minimizes pressure on the workpiece. Solid Kennametal wedges and seats provide close-tolerance, positive positioning of the insert . . . to permit maximum utilization of available power.

Get more information. For dimensional specifications and prices, ask your Kennametal Representative, or write for Supplement No. 9A to our Metalworking Catalog. KENNAMETAL INC., Latrobe, Pa.

*Trademark

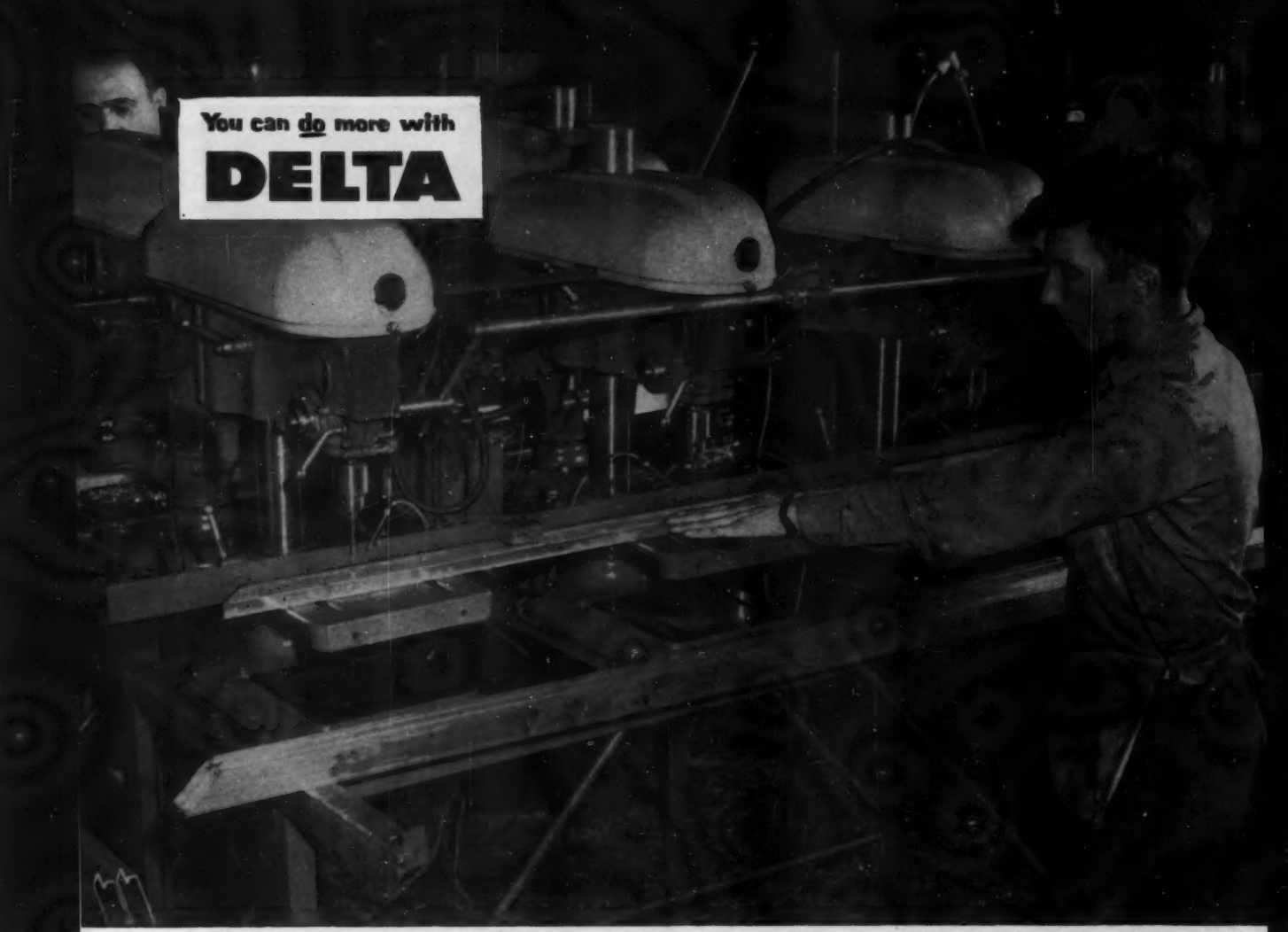
33512

Each ¾-inch square Kennametal insert provides eight separate cutting edges. When one edge becomes dull, the clamp is released and the insert given a quarter turn to a new, sharp edge. It is then reclamped, without need to reset or gage the tool. When all eight edges (four on each side) have been used, the insert is replaced by a new one.

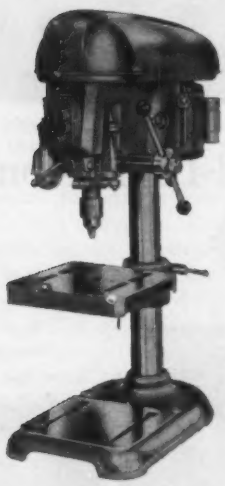
Retracting the wedge, by means of a double-end screw, quickly releases the inserts. *Held in by the screw, the wedge cannot fall out*, regardless of the cutter body position.

INDUSTRY AND KENNAMETAL

...Partners in Progress



Cuts drilling time by 60%



Delta 15" Drill Press, also 20", 17", 14" and 14" Super-Hi Sensitive. Available in floor, bench, and multiple spindle models.

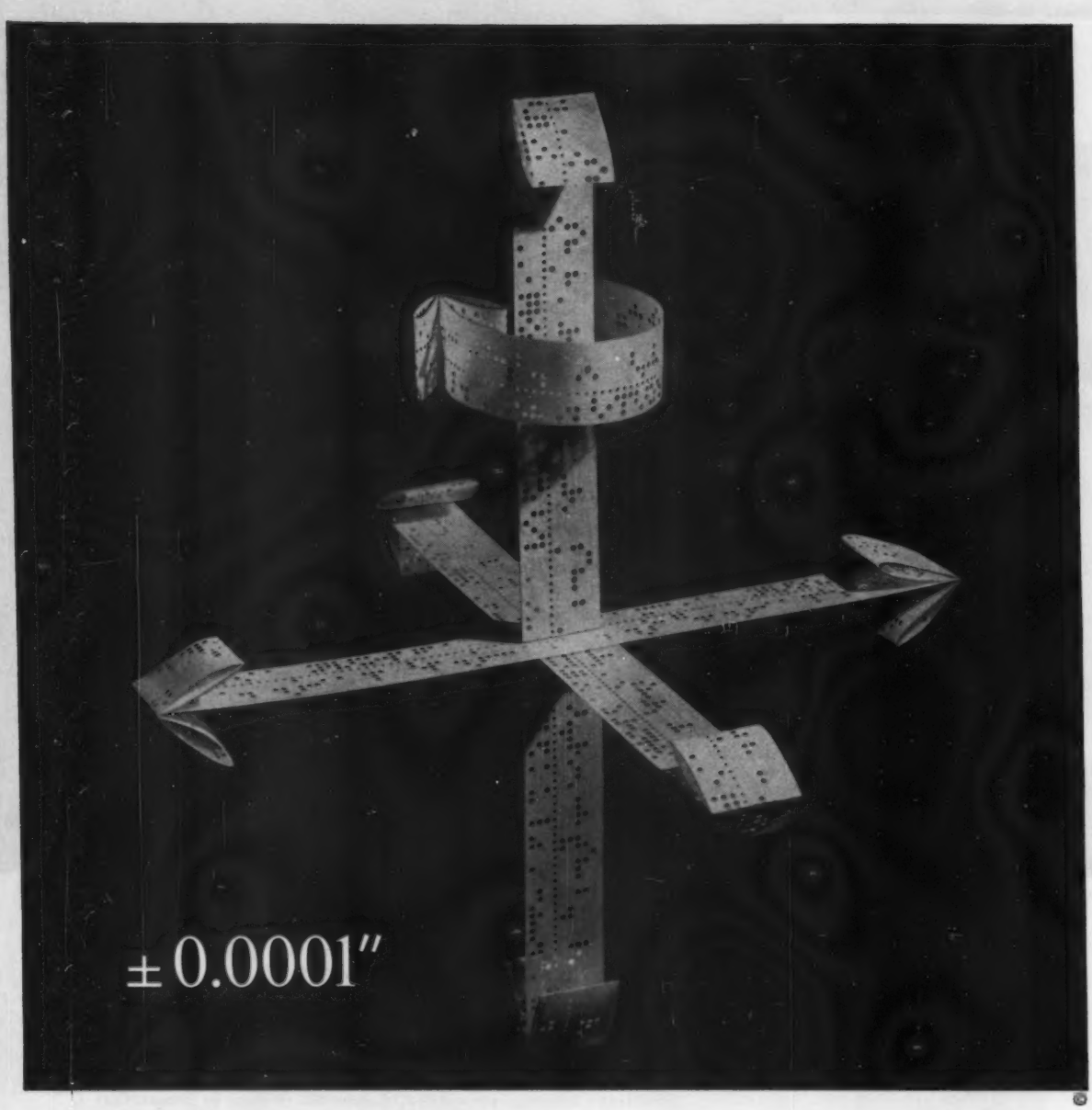
This substantial reduction in drilling time is the result of ingenuity plus a combination of Delta drill presses in two and three spindle set-ups. Spacing machines at a specified distance between holes and using bar connecting operating levers, Capitol Products Company provides *simultaneous* drilling in production of aluminum storm doors. The Mechanicsburg, Pa. firm has standardized on Delta drill presses because these tools assure the adaptability, ruggedness, and accuracy required. In addition, maintenance and servicing are greatly simplified.

Delta drill presses have set the industry standards for years —they cost less to buy, less to operate and less to maintain. Visit your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages)—choose the tool to fit *your* needs from the world's most complete line. For FREE Delta Industrial Catalog showing 61 machines, 302 models, over 1400 accessories, write: Rockwell Manufacturing Company, Delta Power Tool Division, [illegible] N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

DELTA INDUSTRIAL TOOLS

another fine product by

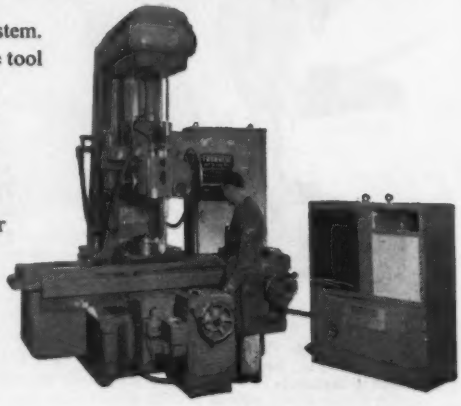
ROCKWELL



PRECISION BORING: Control gains a Third Dimension!

Now Fosdick adds Numerical Depth Control to its unique positioning system. Another loophole for error in precision boring has disappeared. Watch the tool drive smoothly to depth, boring a hole with finer finish, precise in depth and location. Watch the tool advance and retract quickly, saving time. *Tape or dial any depth. Absolutely no stops to preset.*

See how this control signals every tool change and compensates for tools of random length. It was planned when the Fosmatic precision boring machines were designed, so that it fits and takes no extra space. Consider what this new dimension in control means to your critical production jobs. Write for catalog PB-W.



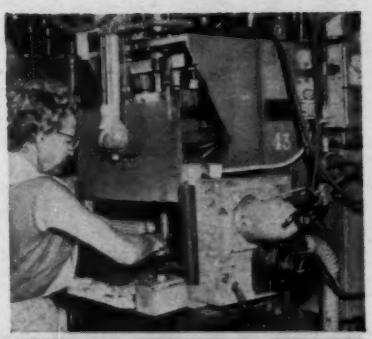
FOSDICK THE FOSDICK MACHINE TOOL COMPANY
Cincinnati 23, Ohio

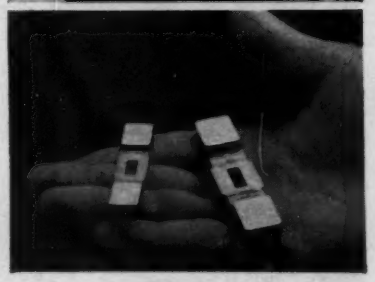
PRECISION Quarterly NUMBER 3

PRECISION WELDER AND FLEXOPRESS CORPORATION, 3520 Ibsen, Cincinnati 9, Ohio

"Unweldable" Alloys Welded

Electrical contacts that won't hold to themselves are welded easily in manufacturing.





MILWAUKEE, WISC. – Engineers at Cutler-Hammer, Inc., have found a way to eat their cake and have it too.

Many of the switches and the circuit breakers which Cutler-Hammer manufactures employ contact pieces made of silver-cadmium-oxide. Such contacts won't stick, burn or weld together when a switch arcs. But the strongest way to fasten a contact to an operating lever is to weld it, so this same quality of "unweldability" creates a critical production problem.

Instead of searching for substitute methods, Cutler-Hammer meets the problem head on – it welds the "unweldable". Six Magna Flash welders made by Precision Welder and Flexopress Corp. are doing this important job at Cutler-Hammer.

Only Magna Flash fuses the entire mating surface between contact piece and the part to which it is welded. The weld is made "in a flash." Moving switch parts welded by Magna Flash can be made lighter and more accurate because they aren't annealed or distorted by the quick heat. The low inertia of light parts means Cutler-Hammer can make faster-acting switches.

For bread and butter welding of silver to copper alloys and stainless to stainless, Cutler-Hammer has a line of 35 Precision Magnetic Force welders. They produce millions upon millions of faultless welds each year, with the highest reliability in the industry. The same current which makes the weld energizes an electromagnet which forges the weld joint at the exact instant of peak heat.

Magna Flash is the refinement of Magnetic Force welding which makes full area welds possible on most materials formerly considered unweldable. With Magna Flash, the low voltage welding current is concentrated on a small nib protruding from the workpiece. This nib vaporizes, ionizing the air gap and triggering the welding arc. Then as the weld surface becomes molten, a magnet instantaneously energizes to produce the precisely timed forging blow.

It's a neat trick, and when your circuit breakers and switches give you extra years of life, there's probably Precision welding behind them.

ON PRESSEMANTICS

THE GREEKS, we are told, differentiated between seven varieties of love, and had a name for each. A similar situation seems to be occurring with presses.

Nobody ever calls a Flexopress a "punch press" any more. They say, "We're running the job on the *Flexopress*," (usually with a wide grin of satisfaction). When they have two Flexopresses the grin is even wider.

This is as it should be: The clumping, garden variety of punch presses relegated to one corner of the vocabulary, and the precise, quiet, rapid Flexopresses set off in their own private bailiwick.

We can see it coming now, the inevitable dictionary definition:

FLEX'O·PRESS: Proprietary name for line of high-speed, C-type and straight side, automatic, precision presses manufactured *by Precision Welder and Flexopress Corporation*, Cincinnati, Ohio. Not to be confused with ordinary punch presses. See *precision, automation, ball-bearing slides, dependability.*

I'd like to have . . . PRECISION

- ☐ Bulletin MF-101 on Magnetic Force Welders for superior welding of electrical contacts and critical materials.
- ☐ Bulletin G-100, describing the full line of Precision Resistance Welders.
- ☐ Bulletin AFP-101, describing Precision C-type and straight side Flexopresses.
- ☐ A call from a competent Precision engineer to discuss ways to improve production with ☐ Precision Welders ☐ Flexopresses.

PRECISION WELDER and FLEXOPRESS CORPORATION, 3520 Ibsen Ave., Cincinnati 9, Ohio

JONES & LAMSON TURRET LATHES

the man who needs a new machine tool is already paying for it

Single point threading to a finish of 15-20 RMS is completely automatic–and fast

The I. D. of these large cap-nuts is approximately 5¼″. The material is High Chrome Nickel Steel, Rockwell C 30–32. The thread is 8 pitch, 5 ½″ long, *and tapered .005″ per inch.*

It's a tough job to make time on, but a J & L Turret Lathe equipped with an Auto-Threader, does the threading in 5 minutes!

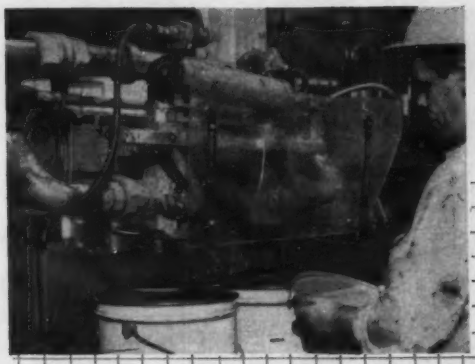
Here's how: The part is faced and a rectifying bore is made; in the same chucking, threading is completed in 16 automatically-controlled passes, with a graduated cutting depth for each pass. *Pitch diameter is held to .002″*, and finish is 15–20 RMS on the flanks.

On the old machine, milling the thread alone took 75 minutes. With this new setup, the entire operation — including loading, facing, boring, threading and unloading — is only 15 minutes.

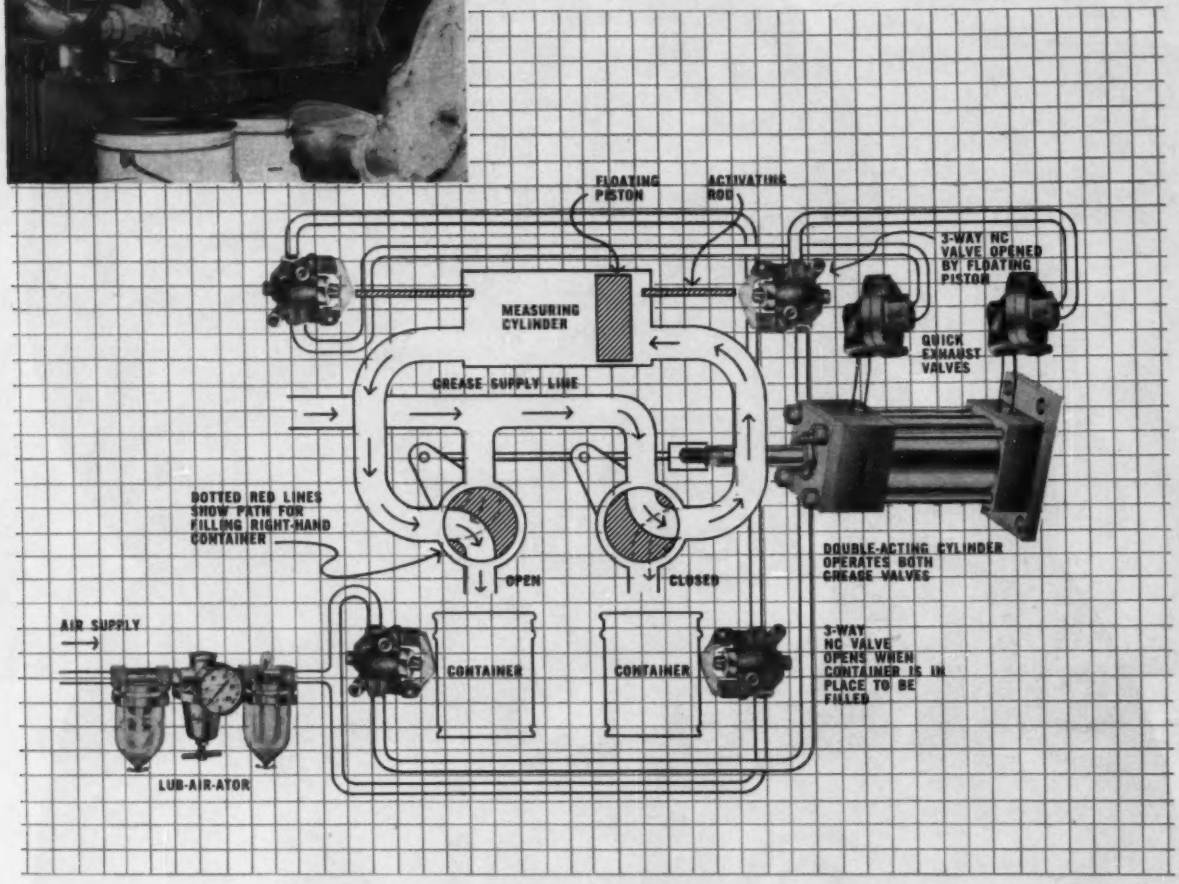
Jones & Lamson Turret Lathes are available with: Completely automatic controls; 45°, 60°, and 180° Tracers; taper attachments, and a variety of other tooling complements, all designed to increase productivity.

Write for detailed information, Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



Here is an example of Schrader at work. Barrett Mfg. Co. of Houston, Texas, makes grease handling equipment for Mobil Oil's Brooklyn, N. Y., refinery. This machine fills 35 pound grease drums automatically accurately, 15 per minute! George Barrett, who designed and built this machine and other machines for Mobil, says: "My reputation for quality is too hard-won to risk by using some inferior line of air products."



PACKAGING EQUIPMENT MAKER DESIGNS MACHINES TO ORDER...AUTOMATES THEM 100% WITH SCHRADER AIR PRODUCTS

In limitless combinations, Schrader Air Products are performing thousands of jobs in thousands of plants. Wherever jobs are messy, tricky, heavy, monotonous or complicated—it pays to talk to Schrader.

Air is already available to you. Put it to work—on your own operations, or on the equipment you make for resale, like the company shown above. Just tick off its advantages: high speed and accuracy, low cost and maintenance—plus safety, simplicity, dependability. Air can do almost anything fingers can—and many things fingers can't.

Both you and your customers want these benefits. Get them—and offer them—by actuating with Schrader—finest, most complete lines of Air Cylinders, Valves and Accessories.

Select from the full Schrader lines to plan your automation of machines. Your Schrader distributor can help you pinpoint what you need. For more data, write:

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

For more data circle this page number on card at back of book

At Raytheon Mfg. Co. . . .

Grinding non-ferrous materials to fine tolerances!

This leading manufacturer of electronic systems uses new hard ceramics as microwave system components. These extremely tough materials presented a difficult grinding problem. It was solved by using diamond abrasive wheels on Blanchard No. 11 grinders. The results were outstanding: Disks measuring approximately 2¼" x ¼" were ground to a tolerance of ±.001", with ⅛" of material removed. Flatness is .002", parallelism .002". These parts are ground at the rate of 48 per hour, and surface finish is consistently excellent.

Write for your copy of "Work Done on the Blanchard".
THE BLANCHARD MACHINE COMPANY
64 State Street, Cambridge 39, Mass., U. S. A.

BLANCHARD

TOUGH, ON-THE-JOB TESTS LIKE THESE CONVINCE USERS

Texaco Cleartex Performs Better

ON BOTH CUTTING AND LUBE SIDES!

Company A: a leading bearing manufacturer (name on request).

Job: forming and cut-off of 52100 and C-1118 tube stock for bearing races.

Had been using: three petroleum products; one on lube side, one on cutting side, one to build up cutting oil diluted by lube oil.

TEST: Texaco Lube Engineer recommended dual-purpose Cleartex 140 for *both* cutting and lube sides of 2⅝" Conamatic for thirty day trial.

RESULTS: better finish, improved tool life, no dilution of cutting oil. Company switched *all 30 automatics* to Cleartex. After 6 months, no addition of base oil needed!

Company B: a well-known maker of cable (name on request).

Job: machining 303 Stainless brake cable nipple.

Had been using: three products—lube oil, cutting oil and base oil.

TEST: Texaco Lube Engineer recommended Cleartex 140 for *both* cutting and lube sides of 1⅝" six spindle Greenlee.

RESULTS: after two weeks, company began gradual switch-over of *all 22 automatics* to Cleartex! Got better tool life, improved finish on wide variety of steels, stainless and brass! Six months later—no compounding needed, even after tapping tough stainless!

A Texaco Lubrication Engineer will help you select the Cleartex grade which can give you similar results on your automatics. Just call the nearest of the more than 2,300 Texaco Distributing Plants, or write:

Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

TEXACO

Throughout the United States

Canada • Latin America • West Africa

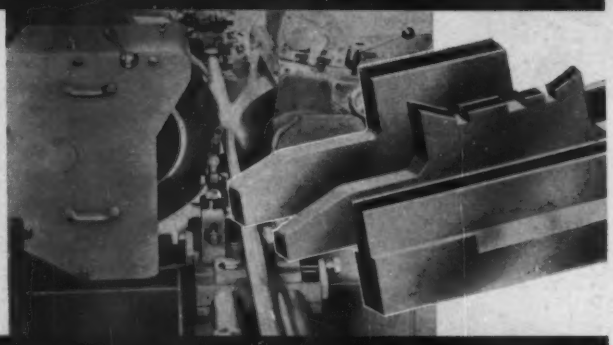
LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

...THREE TALIDE CASE HISTORIES

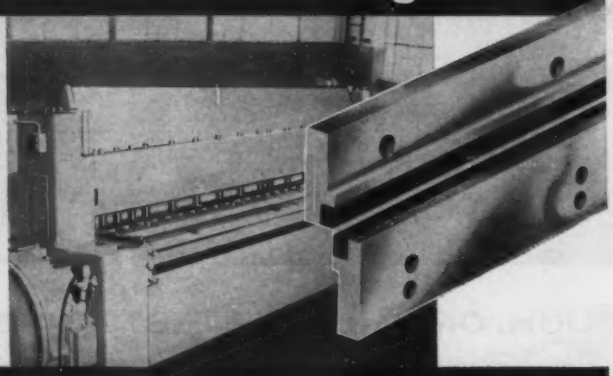
Talide® BLADES for centerless grinding

25 YEARS OF TOP PERFORMANCE using Talide-tipped work support blades on Landis, Cincinnati and Van Norman centerless grinders. Available in lengths up to 120". Tipped with a ONE-PIECE carbide wear strip. No section or seam marks to score or scratch the work. Users prefer blades of Talide superior construction. Over 50 sizes and styles of standard blades are carried in stock. Special blades made promptly to order.



Talide® BLADES for shearing

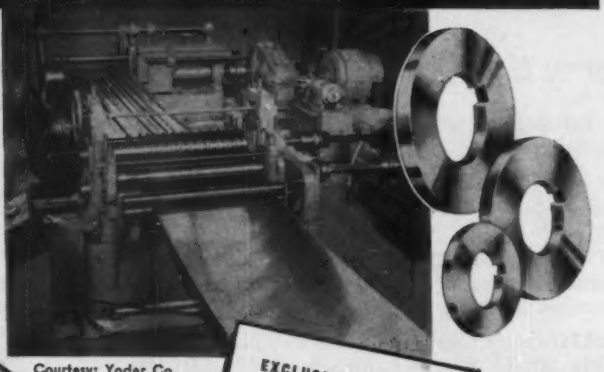
5,631,000 CUTS WITH 59" LONG TALIDE SHEAR BLADES on a Keystone Shear at Westinghouse Electric cutting 29 gauge silicon steel up to 36" wide. 8 months' service life between regrinds saved $2,000 in grinding and set-up time. During this same period it was previously necessary to grind high-carbon, high-chrome blades 24 times — and make frequent replacement. Talide blades normally stay on the job for several years giving high-speed, continuous, burr-free production.



Talide® BLADES for slitting

TALIDE ROTARY KNIVES GIVE PHENOMENAL RUN OF 90 - 1...

A leading strip steel producer of razor blade, high-carbon, spring and stainless steel reports over 1200 coils were gang slitted with Talide knives, compared to 15 coils with steel knives. More tonnage was produced in one regrind of the Talide knives than over the entire life of a set of steel knives. Burr-free, clean-cut edges produced with scrap rate practically eliminated.



Courtesy: Yoder Co.

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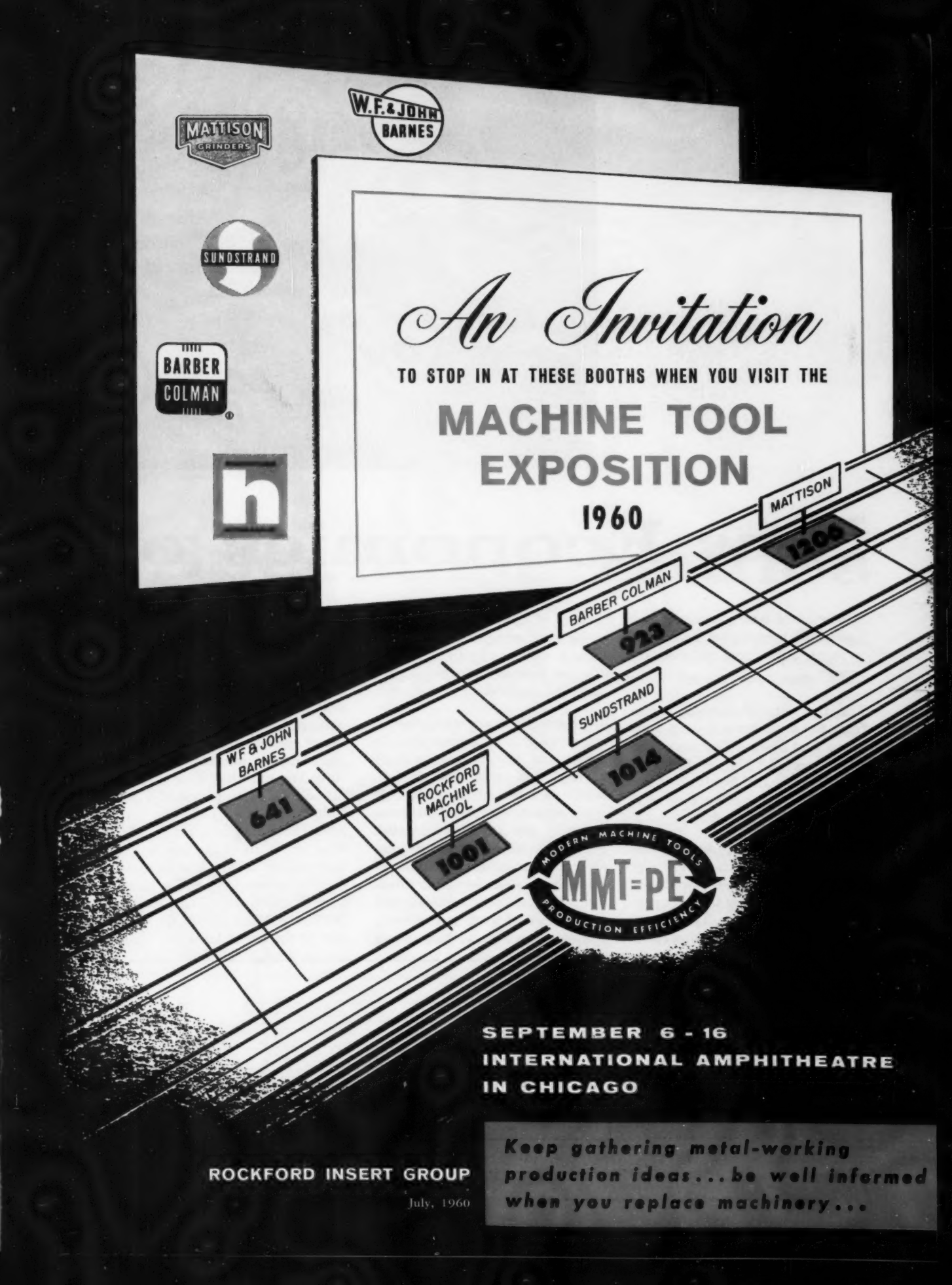
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July, 1960
Keep gathering metal-working production ideas... be well informed when you replace machinery...

New Economics of

Big money being wasted because of traditional concepts in lathe utilization can now be saved.

The two jobs illustrated, taken from the same lathe department, prove that Barber-Colman's new 1610 "specialist" lathe—for turning, facing, and boring—is an economically sound machine concept for almost any shop.

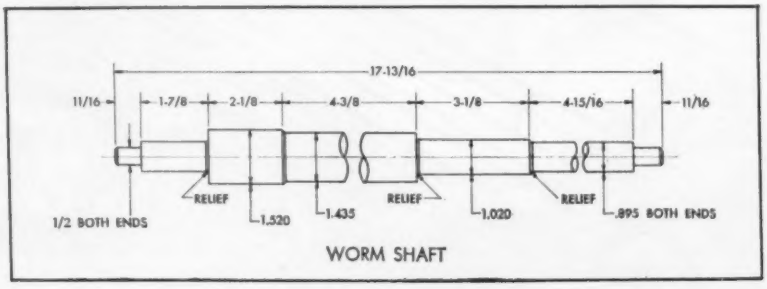
Elimination of threading equipment—features which are not fully utilized on many lathes—produces an initial cost saving that can pay for a hydraulic tracer. The manufacturer of these parts (below) had plenty of threading capacity on older machines, so he elected to take a valuable hydraulic tracer for the cost of threading equipment he really didn't need.

Of course, there are many operating benefits to be gained. Spindle speed and power feed to both carriage and cross slide are infinitely variable. Ability to change both speeds and feeds without stopping the machine increases production on a great many jobs. Over-all result: A new kind of lathe specialization that minimizes capital investment for certain classes of work and opens a valuable opportunity to improve *total* machine utilization. Here are some of the specific results this manufacturer achieved.

The worm shaft was shifted from a turret lathe to the tracer-equipped Barber-Colman 1610 for facing, center drilling, and turning. Threads are now cut on a threading machine. This shift reduced total cutting time 32% and setup time 12% (including time on a threading machine). But time on a machine has to be reckoned in dollars, not minutes. Capital investment in the turret lathe is much more than for the 1610 lathe. What's more, the operator of the turret lathe is a Class

MODERN MACHINE TOOLS MMT=PE PRODUCTION EFFICIENCY

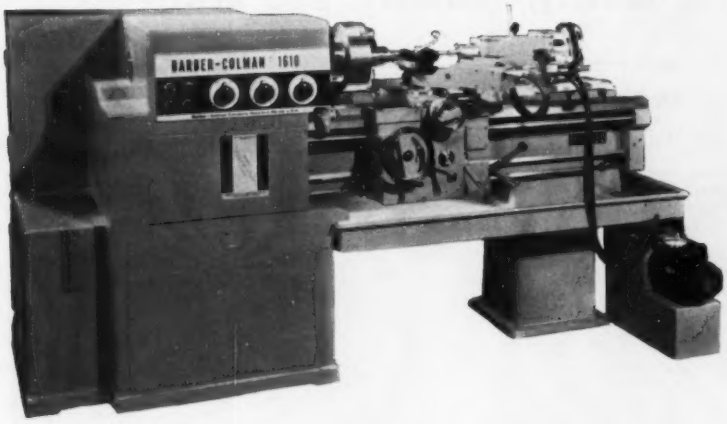
The new 1610 lathe with tracer will be on display in the Barber-Colman Booth (No. 923) at the 1960 Machine Tool Exposition. It will confidently stand your most critical inspection.



WORM SHAFT

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

Report shows how one Barber-Colman turning lathe initiated important methods improvements throughout a department.



"Specialist" Lathes

A, while the operator of the 1610 is Class B. And to further prove how ultimately practical this new lathe is, the Class B operator not only turns out more work, he also scraps fewer parts.

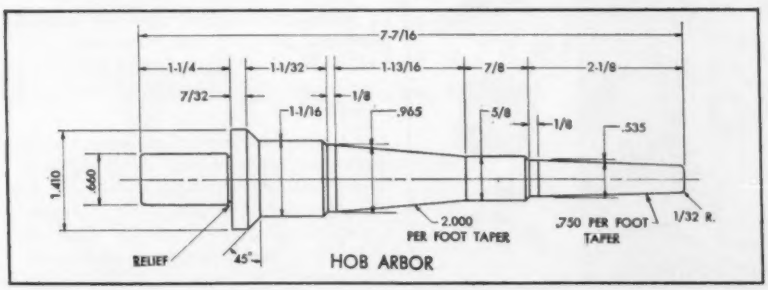
Utilization: tracer vs threading

Perhaps you are in the same position as this manufacturer: You have enough lathes to handle your threading requirements, but not sufficient tracing capacity. If so, a 1610 with tracer will be a particularly profitable investment for you. Take this hob arbor as an example.

By shifting the job from a conventional lathe without tracer to a tracer-equipped 1610, production was increased over 100%—from 1.5 to 3.3 pieces per hour. Setup time was reduced 40%. The important point is, this manufacturer is now using both his old lathes and his new machine more profitably. Here's why.

Maximum cutting speed on the old lathe was 632 rpm and feed was .0092″ per revolution. On the 1610 FT, speed *ranges* from 900 to 1500 rpm and feed is .015″ per revolution. A load meter allows the operator to obtain maximum production. In other words, there's quite a difference in capacity between an old lathe and a modern lathe. And since threading normally requires *slow speeds*, doesn't it make sense to thread on your older machines—and do turning, facing, and boring operations on this high-speed "specialist"? Why put low-speed work on a high-speed lathe?

The 1610, with 16″ or 20″ swing and 6½ hp motor, is a precision lathe capable of turning out toolroom quality work. If you are in the market for a new lathe, phone your Barber-Colman representative or write us for descriptive literature and complete specifications. Ask for Bulletin No. 9061-1.



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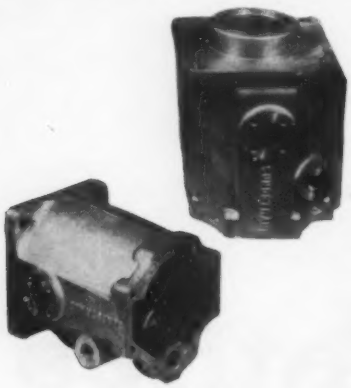
72 Loomis Street, Rockford, Illinois

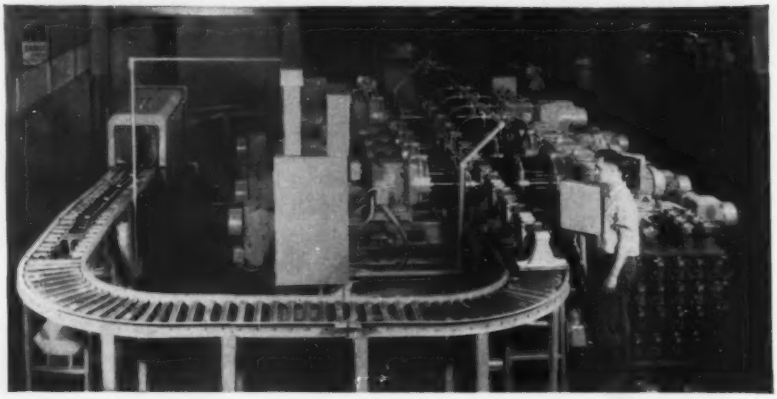
CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

SUNDSTRAND "Engineered Production" METHODS

...practical ideas for men who are responsible for manufacturing quality, quantity, and profit

SMALL-LOT TRANSFER MACHINING *Quickly changed heads and fixtures bring cost cutting transfer line automation to small-lot jobs.*





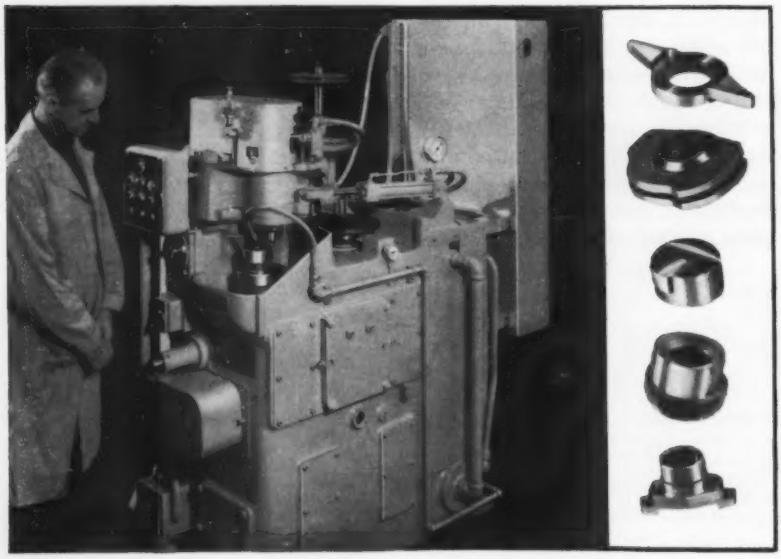
The economies of transfer line processing no longer are limited to large-volume production. This new six-station Sundstrand pallet-type transfer line is being used to process a "family" of five different hydraulic unit housings in lots as small as 500 to 1000 pieces.

The machine drills, spot faces, bores and taps the parts to precision tolerances. Milling and boring heads can be added to or replaced in the line as required. Two men can change a complete machine setup of 12 pallet-supported fixtures and 12 heads in less than five hours.

Constructed basically from standard units with specially designed pallets, fixtures and tooling, this transfer line is a typical result of a Sundstrand "Engineered Production" analysis of a specific machining requirement.

Details on request.

CONTOUR MILLING *Intricate external and internal contours easily milled on small parts with Sundstrand cam-controlled machine.*



This Sundstrand contour milling machine is adaptable to a countless number of cam milling operations on small parts for sewing machines, guns, business machines, governors, and many other products.

The vertical cutter spindle and cam follower spindle are mounted together on a pivoting arm with a 2 to 1 ratio, which reduces any cam error to ½ on the finished part.

One operator is able to attend several of these machines and produce accurate parts faster and more economically than with conventional methods.

A wide variety of machine cycles permits internal and external contour milling of workpieces up to approximately 5" diameter. For complete information, ask for Bulletin CM-617, and describe your requirements.

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

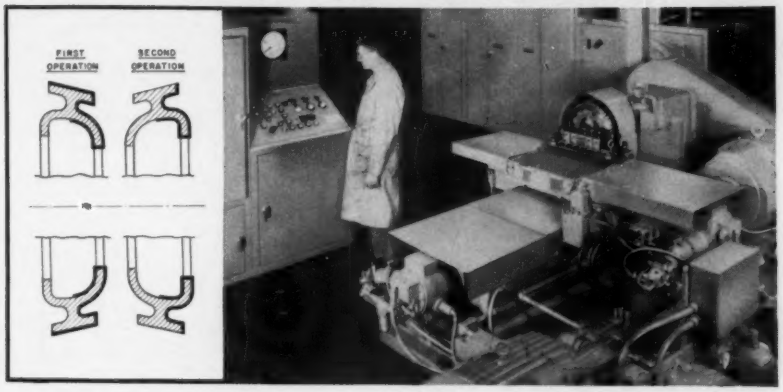
NUMERICALLY CONTROLLED TURNING

Sundstrand lathe turns turbine rings faster, more accurately than by former method.

This new Sundstrand numerically controlled lathe contour-turns stainless steel turbine rings to precision tolerances and finishes in two completely automatic cycles.

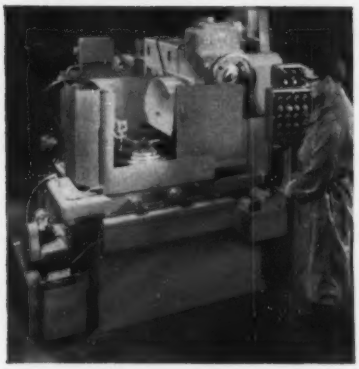
Speeds, feeds, order of presentation of each of the five carbide tools, and the path of each tool are controlled numerically. Production is increased and finish and tolerance more easily maintained than by the former method of machining.

If you want to explore the opportunities for profitable turning in your shop, ask for an "Engineered Production" analysis of your jobs.



ROTARY SURFACE GRINDING

High-production rough and finish grinding of clutch plates to a flatness of .001" with .005" repatability.



Long ways, a rugged column, and precision construction allow this 20-hp Sundstrand-Arter machine to rough and finish grind 14" clutch plates to an over-all flatness of .001", total indicator reading — repeatability within .005" at a rate of 45 sides per hour.

Required finish of 30 to 40 microinches is readily held; but finer finish is obtainable with this machine. Stock removal is from .009" to .012".

The entire cycle is automatic, except for loading and unloading. The operator places a clutch plate on the concentric pole magnetic chuck of the first machine and the grinder fast feeds for heavy stock removal, then automatically changes to slow speed for fine finish. The clutch plate is then reversed and the operation repeated on second machine. Total production thus is 45 pieces per hour (at 85% efficiency).

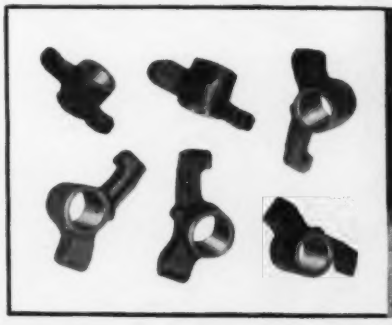
Compensation for wheel wear or wheel dressing doesn't disturb the feed setup on this versatile grinder. Also, it has a tiltable table for concave or convex grinding. Available in toolroom or production types. For details, ask for Bulletin G-617.

BROACHING

Vertical internal pull-up machine with sliding fixture handles 1200 parts per hour, six at a time.

An ideal combination of machine, proper tool design, and an efficient fixture provides highly productive broaching of the ID of hole in the exhaust valve rocker arms illustrated — 1200 finished parts per hour.

The hydraulically operated workholding fixture, designed and built by Sundstrand, features easy loading, positive clamping during broaching cycle, and automatic parts ejection. The operator loads a fixture slide while six parts are passing through the broaching cycle.



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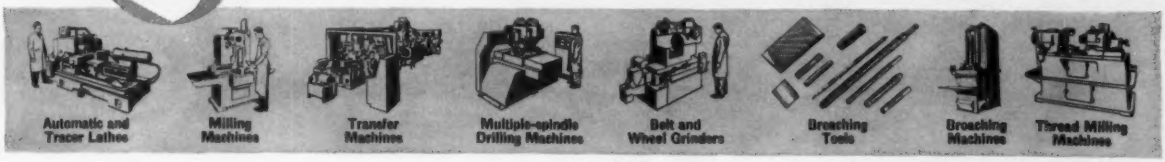

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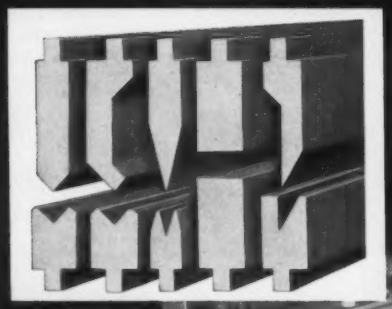
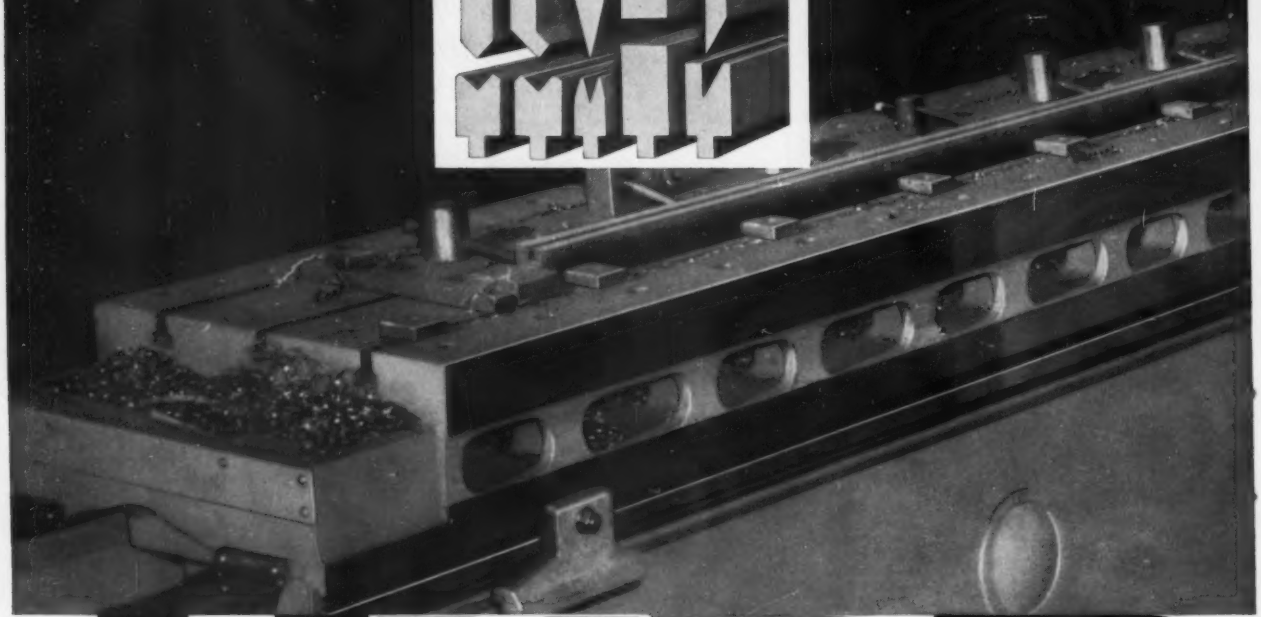
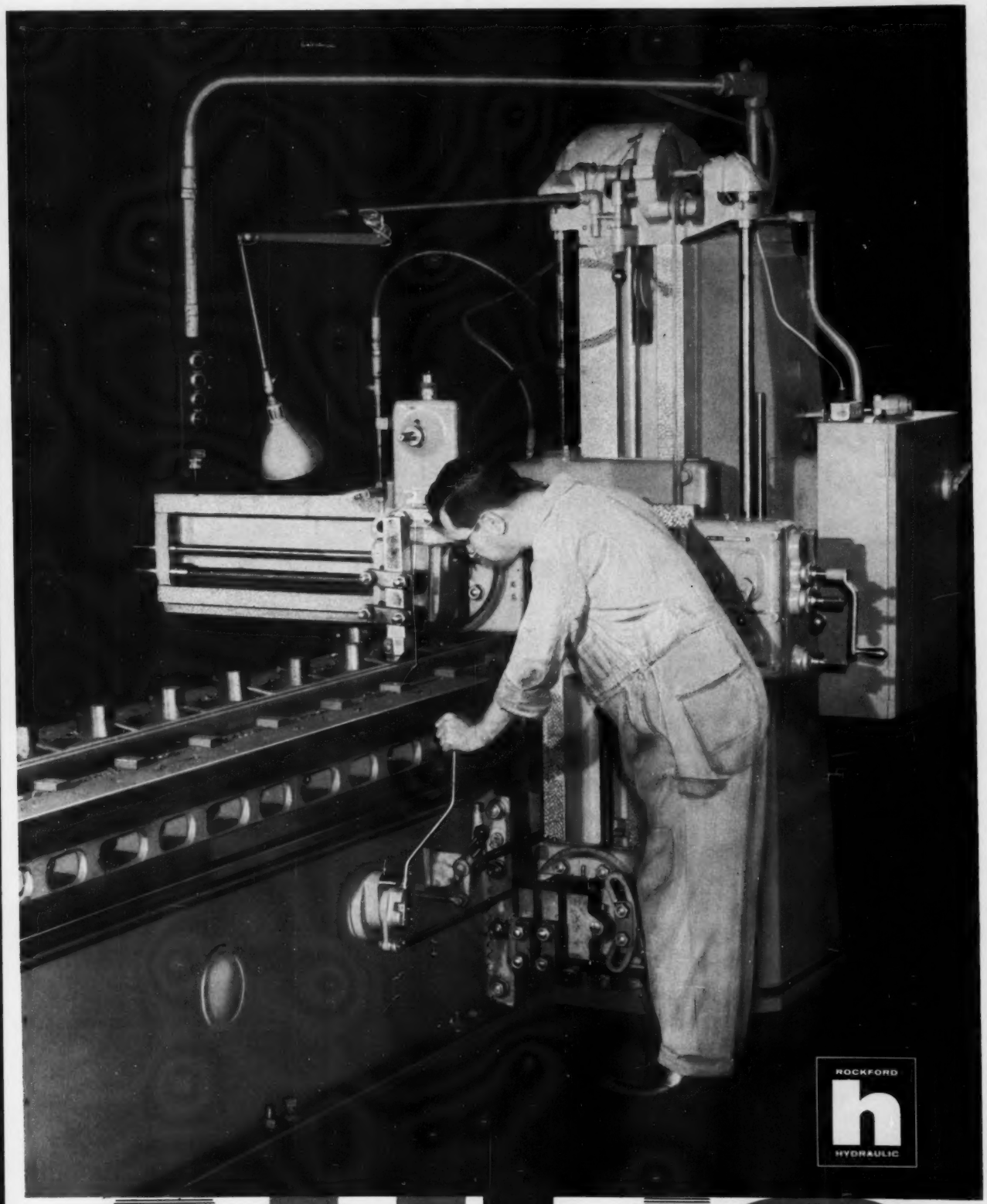




HY-DR

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**



AULIC

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MATTISON
HIGH-POWERED PRECISION

GRINDING METHODS

"Revolutionary" surface grinding method combines accuracy, high productivity

The pump piston cover assemblies below illustrate how a new method grinds pieceparts to flatness tolerances of .0005", removing .004" of stock . . . at a production rate of 140 per hour!

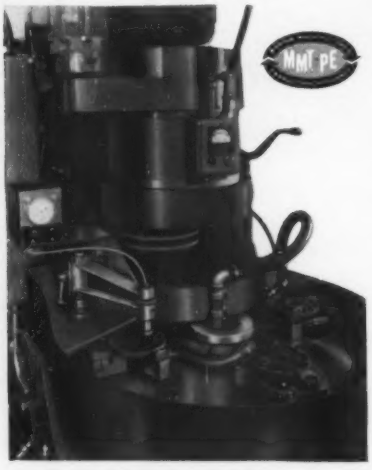
The high-production grinder—Mattison's new rotary *indexing* model—has a planetary head which orbits around the center point of work held by stationary fixtures as they index under the wheel. Here's why this new method can economize *your* grinding for flatness.

1 Equipment costs are lower because it is easier to revolve a spindle than to spin work with separate drives.

2 Holding the piecepart stationary in its fixture keeps work properly oriented for simple loading, transferring, and unloading without danger of mislocation. The process is ideally suited for grinding from the rough on transfer-type machines.

3 Continuous cutting, an advantage of the index-type worktable, increases machine use and production rates.

4 Thin parts, normally resilient under a heavy cut, now can be ground accurately. The cylinder wheel covers a large work surface evenly, reduces pressure on any one section—virtually to zero as the machine sparks out.



Planetary principle speeds production

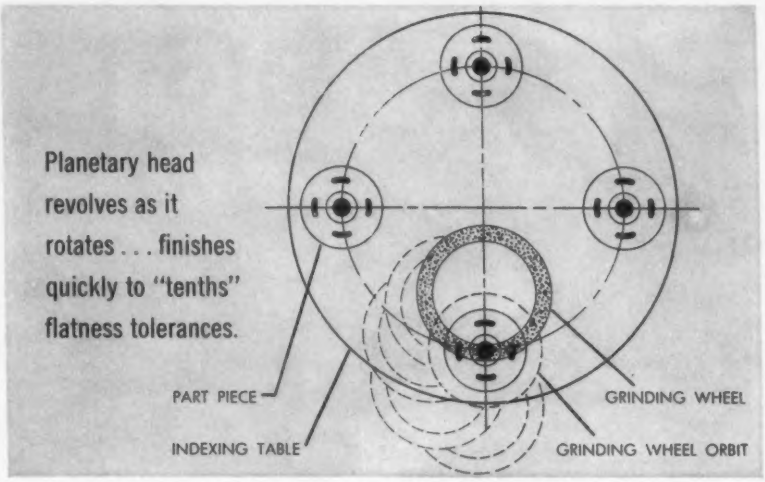
Mattison's planetary head grinder is similar in principle to cutting with a conventional rotary vertical spindle surface grinder. Instead of the piecepart spinning under a stationary spindle, however, it remains fixed and lets the wheel axis revolve around its center point at 60 rpm—approximately in the same speed at which work rotates on a standard machine.

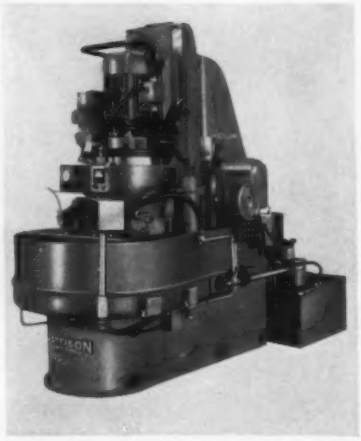
In the grinding job illustrated, work is held by almost zero clamping pressure. This prevents distortion, while holding the parts snugly against stops. Grinding pressure forces the parts *down* against locating surfaces of the fixtures. Loading and unloading are accomplished easily, even while working at very high production rates.

Either fixtures or magnetic chucks may be used, depending on the piecepart shape. Both methods orient work for other stations in index-type, around-the-table, or transfer-type machines requiring vertical, horizontal, or angular-mounted grinding heads.

Mattison's 24AP planetary grinder uses self-dressing wheels. Once the wheel has been trued during initial setup, wear takes place evenly so that perfect flatness results. A post-process gaging system actuates an independent automatic feed for controlling work size.

The planetary wheel head houses either one or two spindles, depending upon production requirements. An auxiliary motor drives the spindle assembly through "V" belts, while the main wheel head motor powers the spindle itself through a timing belt, which revolves radially as it drives.


Planetary head revolves as it rotates . . . finishes quickly to "tenths" flatness tolerances.
PART PIECE
INDEXING TABLE
GRINDING WHEEL
GRINDING WHEEL ORBIT



Mattison No. 24AP permits combinations of grinding with drilling, boring, reaming, and tapping on such parts as electric motor frames, valve bodies, transmission housings, and engine blocks.

Need integrated grinding precision?

If you need precision grinding integrated for assembly-line production, contact your Mattison representative or write to us direct for complete details on the No. 24AP planetary surface grinder.

MATTISON MACHINE WORKS
Rockford, Illinois **Phone: WO 2-5521**

MATTISON MACHINE WORKS

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MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

it took 35 seconds and 52 years to process this Diesel engine block

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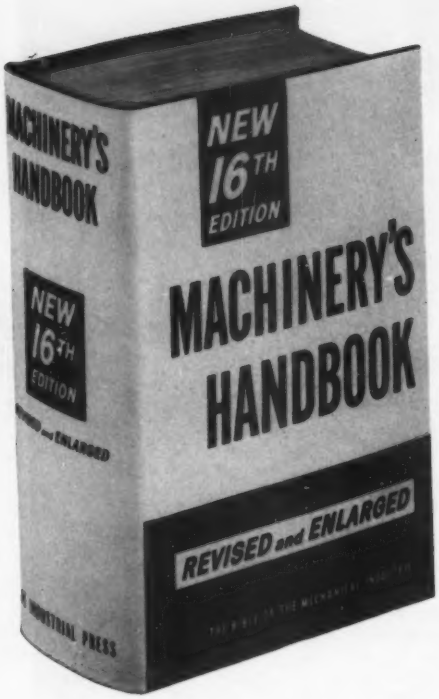
FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.



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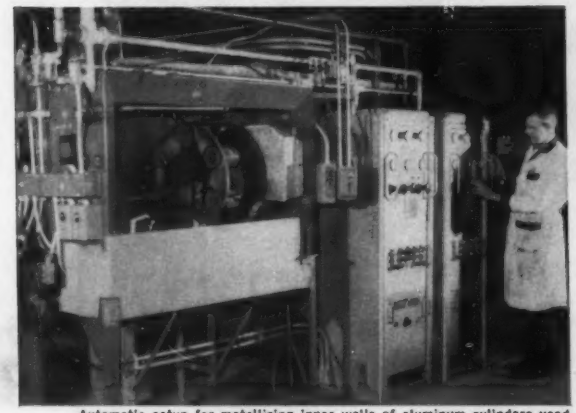


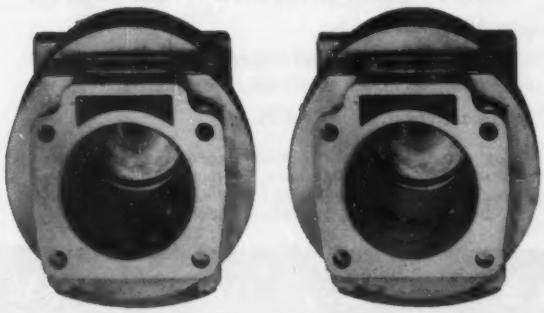
Automatic setup for metallizing inner walls of aluminum cylinders used in lightweight gasoline engines. Cabinet in foreground houses six-station rotary setup; automatic control panels are at right.

Many methods, including cast-iron cylinder liners and chrome plating, have been tested for wear resistance in lightweight gasoline engine blocks of aluminum.

Best of these methods experienced breakdowns in less than 400 hours. Now they are metallized with METCO Sprabond (molybdenum alloy) as a bonding agent, followed by a coating of sprayed steel alloy.

Test runs of over 4,000 hours show little or no wear of the metallized surface. Finish thickness is .007"; weight – a few grams. Cast-iron liners weighed almost ½ pound.

Cylinder at left machined ready for flame spraying; one at right has been metallized and hone finished.



Closeup of automatic six-station rotary setup. Cylinders are individually rotated at 150 rpm. Cylinder is loaded on table at Station 1, moved through Stations 2 and 3 for pre-heating by torch. At Station 4, bonding coat is applied by the gun nozzle which feeds into the rotating cylinder. Low alloy steel is applied at Station 5 and cylinder cools at Station 6. Cylinder walls are finished by honing.

New engineering data bulletin

Bulletin 136B—The METCO Flame Spraying Processes, provides basic engineering and application data on flame sprayed coatings of metals, ceramics, carbides and other high melting point materials. 16 pages. Send coupon for free copy.

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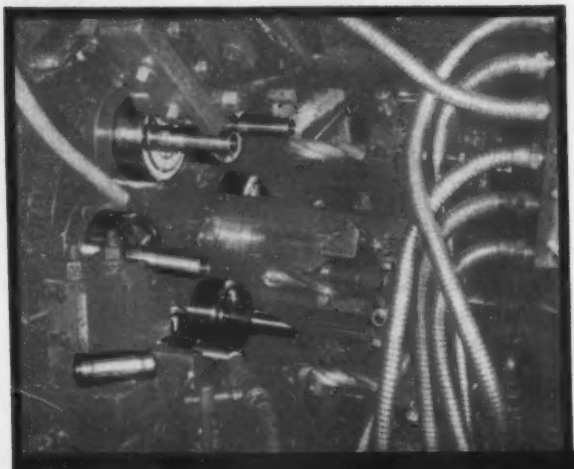
and **HARDINGE Style "B" Master Feed Fingers and Pads**

Photo of Model 601 New Britain Automatic courtesy New Britain-Gridley Machine Division.



Your automatics perform best with HARDINGE Master Feed Fingers and Master Collets. The name HARDINGE is your guarantee of accuracy and durability . . . allows you to reap the full benefit of the inherent accuracy of your machines.

HARDINGE Master Collets are ***the only masters with no work pressure on the screw*** . . . last longer . . . retains accuracy.

HARDINGE Master Feed Fingers and Pads save 30% to 80% over conventional solid feed fingers.

All sizes for all automatics.

Prompt Delivery from these Stock Locations: Atlanta, Boston, Chicago, Dayton, Detroit, Elmira, Hartford, Los Angeles, New York, Philadelphia (Yeadon, Pa.) Seattle, Portland, Minneapolis, Oakland, St. Louis, Springfield, N.J., and Toronto.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

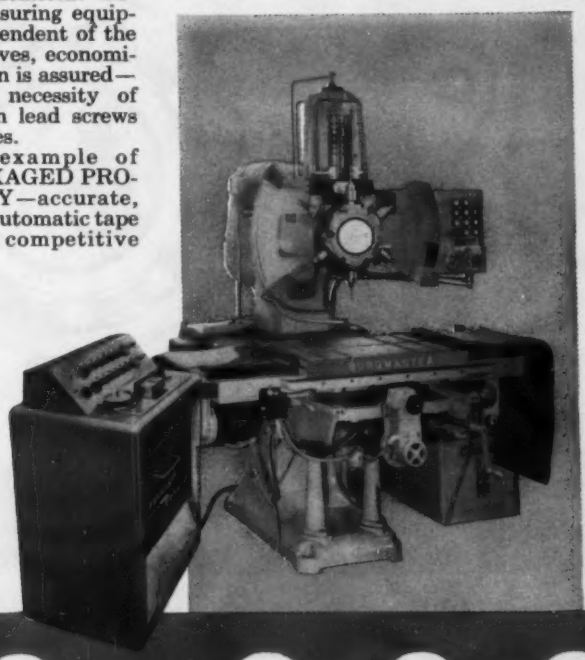
POSITIONING BREAKTHROUGH!

BENDIX ANNOUNCES Numerical Control System for point-to-point work

Long a leader in the numerical contouring field, Bendix has acquired exclusive U. S. sales and service rights on the Ferranti FP-22 numerical POSITIONING control system for machine tools.

The FP-22 is truly the practical answer to the positioning requirements of jig borers, drilling machines, punch presses and other point-to-point applications. Because its measuring equipment is independent of the machine's drives, economical installation is assured—without the necessity of ultra-precision lead screws and gear boxes.

Another example of Bendix PACKAGED PRODUCTIVITY—accurate, dependable, automatic tape control for competitive efficiency.



Position display numbers shown here are actual size.

Outstanding features of the Ferranti FP-22 include:

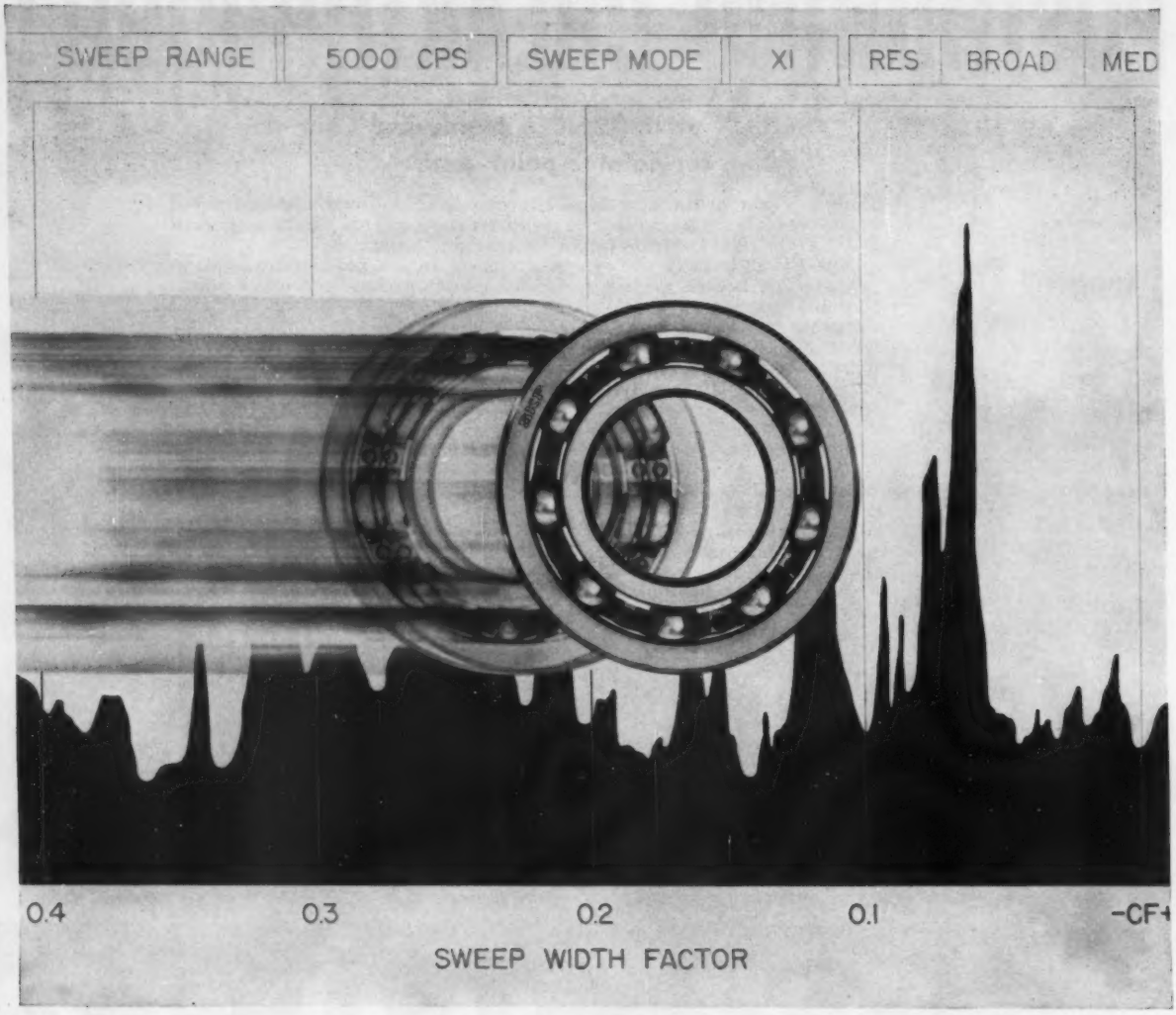
Floating zero—quick and easy set-up—low cost tooling.
Dial input—provides manual operation flexibility.
Continuous position display—available as an option.
"Accumulator" power supply—eliminates line voltage fluctuations.
Fully transistorized—requires less warm-up time—less power—less maintenance.
No contacting parts in measuring units—no wear—no eventual loss of accuracy.

Backed by complete service and customer training programs.
For additional information, contact your machine tool distributor or Bendix.

Industrial Controls Section
21820 Wyoming, Detroit 37, Michigan

THE Bendix CORPORATION

For more data circle this page number on card at back of book



Now, SKF reduces the noise level of ball bearings by 50%!

New SKF ball bearings run twice as quietly as standard single-row deep-groove bearings – six times more quietly than bearings produced just two years ago.

They're designed especially for applications where noise is an important factor. Eight manufacturers, who use-tested them for over a year, now back-up their approvals with repeat orders.

Every bearing meets new, more critical standards. Each type and size meets special requirements for reduced vibration. Every ball meets very low waviness limits. Each cage meets critical standards for smooth, quiet performance.

SKF will make a comparison check of these improved bearings against the bearings you're now using. See for yourself! Just call the SKF branch office nearest you. 6013

Spherical, Cylindrical, Ball, Conrad® Tapered and REED Miniature Bearings

EVERY TYPE—EVERY USE

SKF®

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

®REG. U.S. PAT. OFF.

INSPECTION BREAKTHROUGH!

BENDIX ANNOUNCES New Coordinate Machine that inspects work pieces up to 10 times faster

The Bendix Industrial Controls Section and Ferranti, Ltd. have teamed up to bring the American metalworking industry a new concept in two-dimensional inspection equipment.

The revolutionary FI-22 coordinate measuring machine provides direct and continuous readout of hole center locations with one-set-up simplicity and with 0.001" accuracy over its entire 15" x 24" range.

Operator errors due to misuse or misreading of inspection instruments are essentially eliminated—one inspector can do the work of several with the help of the transistorized counting circuits and advanced mechanical design of the FI-22.

14·350+

Readout display numbers shown here are actual size.

The FI-22 features such other advantages as:

Large readout display—one set for each axis—little chance to misread these bright, ¾-inch digits.

Floating zero—set up at any point—measure in any direction.

Doubles as layout machine—for still further time savings.

Interchangeable probe tips—inspect any hole or surface location.

Backed by complete Bendix service and customer training programs. For additional information, contact us today.

Industrial Controls Section
21820 Wyoming, Detroit 37, Michigan

THE Bendix CORPORATION

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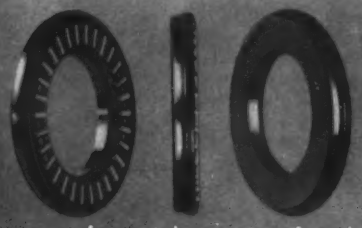
Deriving from well-known NADELLA Needle Thrust Bearings

NADELLA

HIGH-PRECISION
NEEDLE THRUST BEARINGS



ensure perfect axial retention of machine tool spindles and other high-precision rotating machine components.

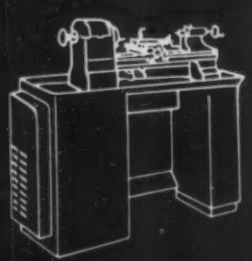
Exceptional Load Capacity
Outstanding Rigidity even under Variable Load
Normal Tolerance ± .00004"
(closer tolerances on request)
Bearing precision completely unaffected by centrifugal forces acting on rolling elements

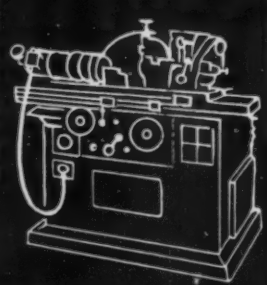
These thrust bearings are suitable for all normal speed ranges, including high-speed machining by carbide and ceramic cutting tools. NADELLA Needle Thrust Bearings meet tomorrow's machining precision requirements today. You can safely put your trust in the traditional craftsmanship and skill of Swiss precision engineering backed by NADELLA's 30 years experience in the production of needle bearings. Complete range of metric sizes from 15 mm (19/32") to 120 mm (4 3/4").

ACTA 2012 B

Some typical applications where NADELLA super-precision needle thrust bearings have scored :

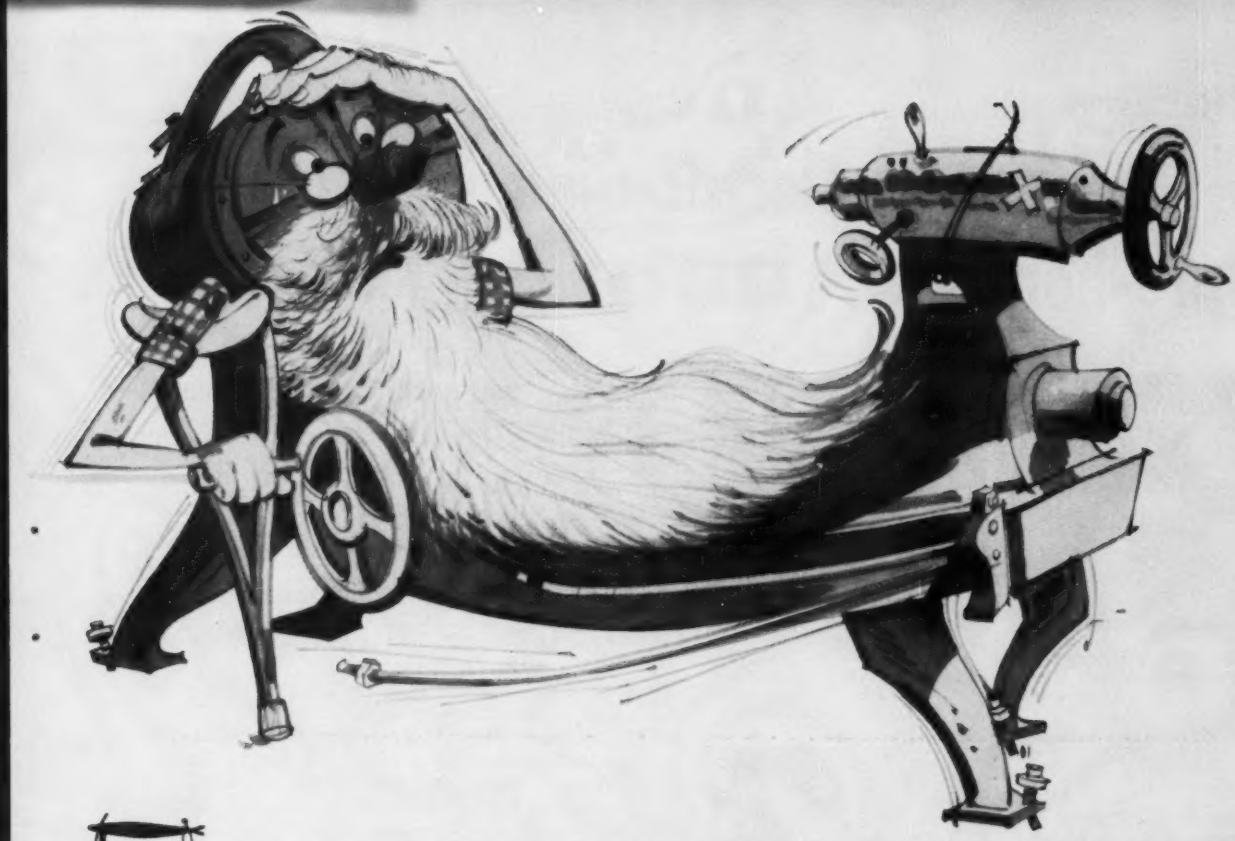
- **Precision lathe spindle**, mounted on 35 mm (1 3/8") i. d. NADELLA needle thrust bearings. Excellent surface finish, outstanding dimensional accuracy of machined faces, direct finishing to closed tolerances.
- **Worm of indexing table for jigboring machine**, mounted on 40 mm (1 9/16") i.d. NADELLA needle thrust bearings (ultra-precision grade). Indexing accuracy ± .00001".
- **Milling machine spindle**, mounted on 120 mm (4 3/4") i. d. NADELLA needle thrust bearings. Performance proved so satisfactory that preliminary rough machining passes produced a surface precision and finish equal to the finishing pass.
- **Work-holding spindle** of grinder, mounted on 50 mm (2") i. d. NADELLA needle thrust bearings. Complete absence of lateral movement and outstanding dimensional accuracy in surface grinding; excellent surface finish.

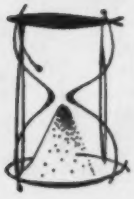




WÄLZLAGERFABRIK BIEL A. G.

SOLOTHURNSTRASSE 66/68 - **BIEL** (SWITZERLAND) TEL. 032-4.20.31





Every Year: *the whiskers on America's old lathes grow longer!*

... And as a manufacturer don't you find imports and substitutes grabbing more and more of your markets every day? Largely on a price basis?

Any connection between antiquated lathes and lost markets? You know it!

Consider these alarming facts. In 1945, 38% of all America's machine tools were ten years old or older. In 1953, 55%. In 1958, 60%. Yes, 60%!

The lathe story is even more disturbing. Right now 72% of all engine lathes are over 10 years old. Almost 40% of these are over 20 years old.

Think of that in terms of productivity. A twenty-year old 16" slowpoke, with a 7½ H.P. motor, delivers a top metal removal rate of 9½ cubic inches per minute. A ten-year old with 10 H.P. delivers a 15 cubic inch rate. *And yet today's Monarch 20 H.P. job throws chips at a 36 cubic inch rate.*

There are other factors, too. With old machines, the cost saving advantages of throwaway tools and negative rakes cannot be realized. High temperature alloys and many other materials cannot be turned economically without today's oxide and harder TiC carbide tools. And savings on modern lathes with tracer controls are phenomenal.

As never before, American industry must today study every avenue of possible cost reduction. For some, it may be a matter of sheer survival. Ancient lathes will not help meet tomorrow's competition. Modern Monarchs will ... *The Monarch Machine Tool Company*, Sidney, Ohio.

Not one of these MODERN MONARCHS was available 5 years ago. Some, not even a year ago.

Series 62 Preselector Dyna-Shift Lathe
Series 80 Heavy Duty Dyna-Shift Lathe
Series 90 Heavy Duty Dyna-Shift Lathe
Series 180 Ultra-Precision Contouring Lathe
The Missile Master
Rotary Profile Tracer Lathe
... And Others

Monarch
TURNING MACHINES
ACCURACY • ECONOMY • LONG LIFE

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

For more data circle this page number on card at back of book

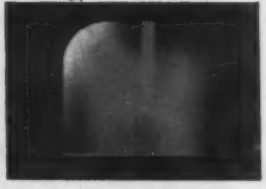
Metallurgical Memo from General Electric

General Electric announces pre-honed CARBOLOY® inserts

Hand-honing is inaccurate, and time-consuming—frequently results in premature chipping and breaking.

Chamfered, or ground-flat, edges are geometrically weaker than a radius and are more easily chipped or broken.

Unhoned or as-ground inserts show rough edges—result in unpredictable tool life due to chipping.



Shown here, both under magnification and graphically, is an edge of the new Carboloy pre-honed insert. Radius is geometrically ideal to minimize chipping, extend tool life many times.

Now you get more predictable tool life... lower cost per cutting edge ...no hand-honing cost!

Ready-to-use... honed to a precise radius... promise BETTER PROFITS THROUGH BETTER TOOLING

Now General Electric Carboloy inserts are pre-honed *at the factory!* Here's what it means to you:

1. An insert with edges honed to precise *radii* gives the strongest geometric shape to withstand cutting pressures. This reduces chipping – increases the predictability of tool life. Hand honing *cannot* achieve precise radii – G-E pre-honing can . . . and does!

2. Since chipping is minimized, fewer cutting edges are wasted. The result is lower cost per cutting edge.

3. Since inserts come pre-honed and ready-to-use, the labor cost of hand honing is eliminated. This more than offsets the charge for pre-honing.

4. Pre-honed Carboloy cemented carbide inserts have standard edge radii honed to a greater or lesser degree, depending on the job to be done. You'll *know* the honing is right!

Ask your Authorized Carboloy Distributor about pre-honed Carboloy inserts, convertible seats, toolholders, and brazed tools. Or, write: *Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Road, Detroit 32, Michigan.*

TOPS IN TOOLING QUALITY

From the research and quality-control facilities of the Metallurgical Products Department of General Electric comes the outstanding quality tooling line in the metalworking industry. The new Carboloy pre-honed inserts, as well as the complete line of Carboloy toolholders, inserts, insert seats, convertible seats, and brazed tooling, are designed to meet every tooling need efficiently and economically.

CARBOLOY
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

HERE'S YOUR RAPID REGISTRATION CARD FOR

THE MACHINE TOOL EXPOSITION–1960

Fill out one of these cards (typewritten) and bring it with you to the registration booth at the Exposition. DO NOT MAIL THE CARD IN ADVANCE. Present the card with your $3.00 registration fee and you will save yourself time. **DO NOT TEAR OFF THE END STUB.** This will be your IDENTIFICATION BADGE AND ADMISSION TO BOTH THE MACHINE TOOL EXPOSITION and PRODUCTION ENGINEERING SHOW.

EXPOSITION HOURS:
10 A.M. to 5:30 P.M.
Daily except Sunday, Sept. 11.

SAVE THIS BADGE. It admits you without further registration fee to the **PRODUCTION ENGINEERING SHOW** on Navy Pier
1 P.M. to 10 P.M.
Daily except Sunday, Sept. 11.
(General public and children not admitted to either exposition.)

Registration Fee $3.00
Payable on arrival at exposition.

The NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION invites you to attend

THE MACHINE TOOL EXPOSITION 1960

MMT-PE

INTERNATIONAL AMPHITHEATRE
CHICAGO, ILL.
SEPT. 6-16, 1960

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The first industry-wide exhibit of U. S. A. machine tools since 1955

THE MACHINE TOOL EXPOSITION—1960 THE MACHINE TOOL EXPOSITION—1960

NAME _____
TITLE _____
COMPANY _____
CO. STREET ADDRESS _____
CITY _____ STATE _____

NAME _____
TITLE _____
COMPANY _____
CO. STREET ADDRESS _____
CITY _____ STATE _____

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION
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YOUR NAME _____

TITLE _____

B

COMPANY NAME _____

C

STREET ADDRESS _____

CITY _____ ZONE ____ STATE _____ D

MAJOR PRODUCT OF YOUR PLANT
Please be specific
_____

YOUR HOTEL _____

Please check department in which you are employed.
1. ☐ Management 2. ☐ Engineering 3. ☐ Production
4. ☐ Sales or Adv. 5. ☐ Purchasing 6. ☐ Other, please specify
_____

Please check the number of PRODUCTION workers employed at YOUR plant.
1. ☐ Less than 20 2. ☐ 20 - 49 3. ☐ 50 - 99 4. ☐ 100 - 249
5. ☐ 250 - 499 6. ☐ 500 - 999 7. ☐ 1000 - 1999 8. ☐ Over 8000

NMTB 614

For additional tickets, and complete information write to: National Machine Tool Builders' Association 2139 Wisconsin Ave., Washington 7, D.C.

Fill in card and stub COMPLETELY. Use TYPEWRITER only.
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YOUR NAME _____

TITLE _____

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COMPANY NAME _____

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STREET ADDRESS _____

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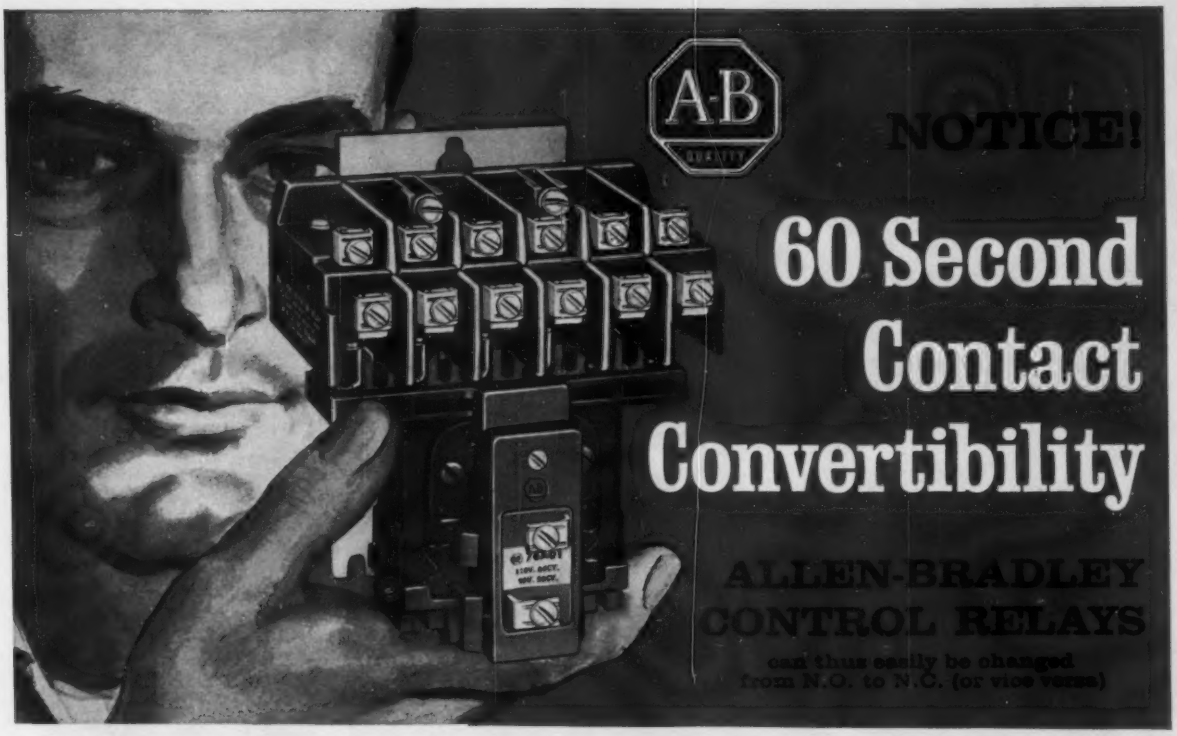
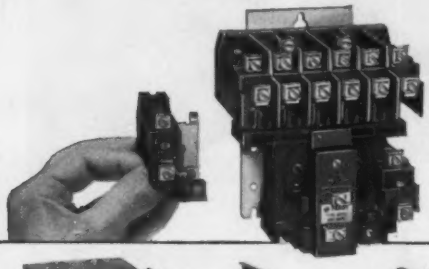


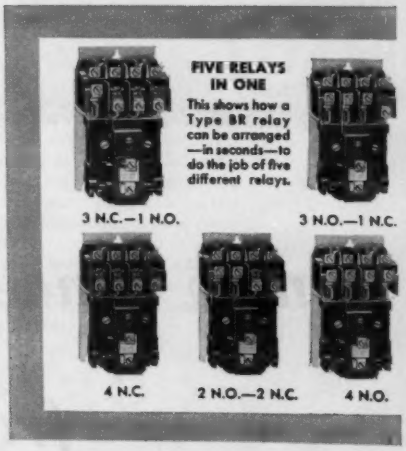
Why not give yourself a real surprise! We refer to the ease with which you can convert the contacts of these Allen-Bradley Bulletin 700 Type BR control relays. Using only a screwdriver, contacts can be changed from normally open to normally closed (or vice versa) in seconds—without removing the relay from its mounting—or its wiring. This "on-the-spot" convertibility certainly suggests an appreciable moneysaving reduction in your relay inventories.

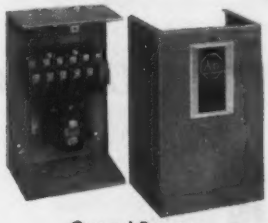
Extensive tests have proven conclusively that the Bulletin 700 Type BR relays are good for many—and we mean *many*—millions of trouble free operations. A "built-in" permanent air gap completely eliminates all possibility of magnetic sticking. Naturally, the double break, silver contacts never need attention. Also, the molded coil is your assurance that even the most severe atmospheric conditions cannot cause trouble. Please write for full details on these relays today!



BUT HEAR THIS!

In the event that when "on-the-job" it is discovered that something was either overlooked or added, the standard Bulletin 700 Type BR—either 2, 3, 4, or 6 pole relay—can easily have added to its base, out in the field, either one or two switching poles. It is done as easily as "falling off a log."


FIVE RELAYS
IN ONE
This shows how a Type BR relay can be arranged —in seconds—to do the job of five different relays.
3 N.C.—1 N.O.
3 N.O.—1 N.C.
4 N.C.
2 N.O.—2 N.C.
4 N.O.



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NEMA 1

Explosion-proof
NEMA 7

Waterproof
NEMA 4

ALLEN-BRADLEY

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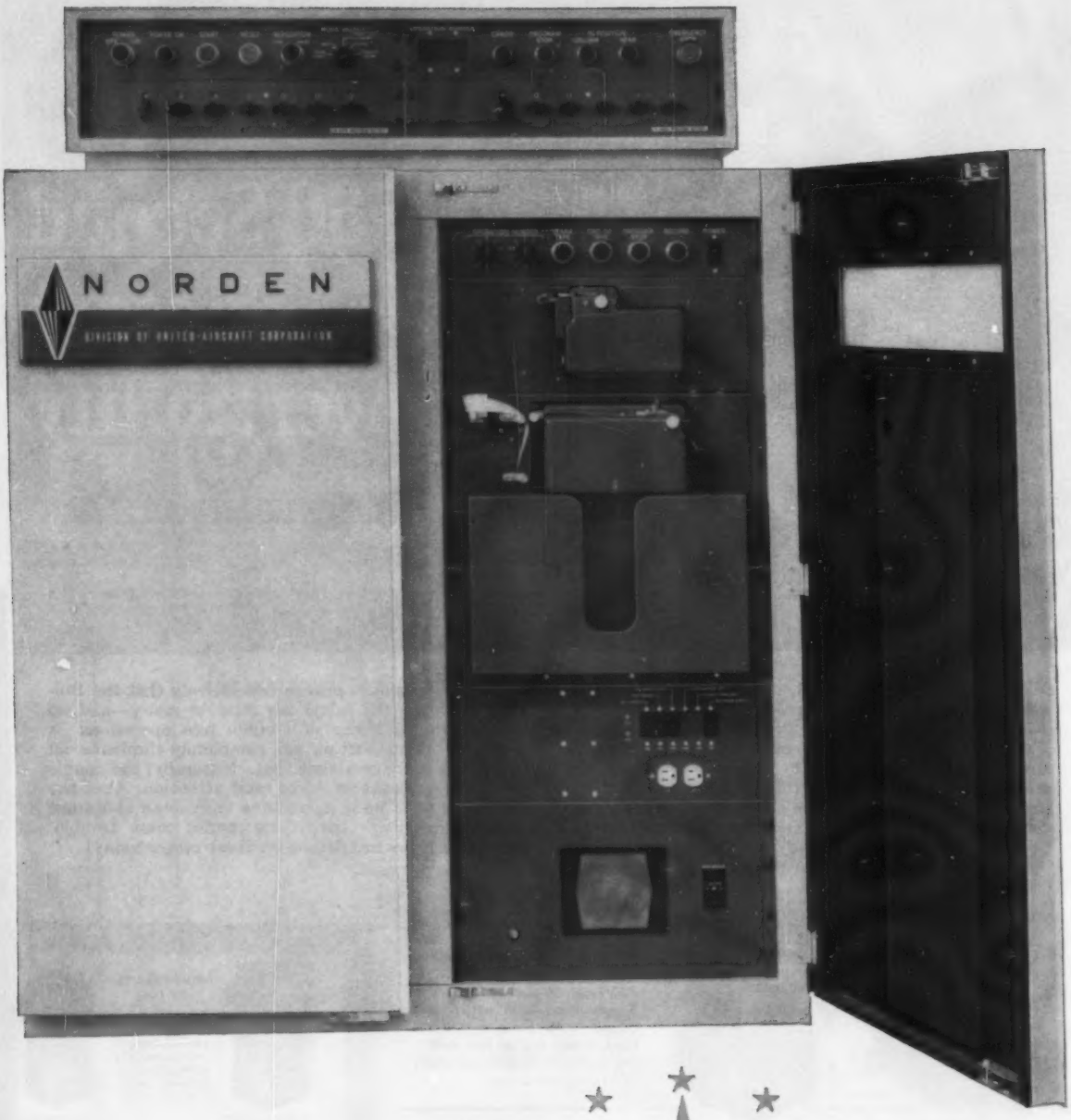
Allen-Bradley Co., 1331 S. First St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL



A new concept in Numerical Control

from ★ **NORDEN** ★

DIVISION

NORDEN Modumatic Control Systems feature display of actual position

■ **With Norden unique components you can automate as much or as little as you need.** This new concept in numerical control is made possible by the exclusive design of a position feedback transducer, electronic circuitry and visual display. These units are available in various systems to show the exact position of the moving members of a machine at all times.

EXACT POSITION READOUT

Series 100—This system displays in straight decimal form the exact position of the tool or work piece. One display is used for each axis of motion.

Features—Illuminated numbers, readable from twenty feet—individual plug-in decimal units—display unit can be located on machine or remote.

AUTOMATIC POSITIONING

Series 600—A completely automatic positioning system with input from either manual dial-in switches or punched tape. Display units provide decimal readout of actual position—not command.

FULL RANGE ORIGIN SELECT

Both **Series 100** display and **Series 600** positioning systems can be supplied with full range electronic origin select. Any desired offset is quickly and easily dialed in by the operator on manual selector switches

Features—Eliminates time consuming readings and calculations—eliminates human error—provides offset calculation automatically—displays exact position numerically.

CONTROLLED PROGRAMMING

These systems are available with automatic tape punch units for tape preparation "on the machine." This provides a permanent inspection record or a programmed tape for playback applications.

PROGRAMMED DIMENSIONAL INSPECTION

This new Norden concept now makes possible automatic inspection of parts by measuring their exact shape and contour. Since each point on the part's surface has a digital value this information can be easily programmed. Corresponding points on the actual part can be probed automatically and their dimensions compared with the programmed information. The system can be provided with direct numeric print or readout of actual dimensions, deviations from nominal, or out of tolerance indications. In addition, punched tape output is available.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

When in Chicago see us at the Production Engineering Show, Navy Pier, Booth 221. At the National Machine Tool Builders Exposition, see Norden Controlled Machines exhibited by G. A. Gray Company, Atlantic Machine Tool Works, LaPointe Machine Tool Company.

For more information contact your nearest Norden Representative, 400 Main Street, E. Hartford, Connecticut, JAckson 8-4811, 11 West Monument Avenue, Dayton 2, Ohio, BAldwin 8-4481, or write us at the address below.

OF UNITED AIRCRAFT CORPORATION

DATA SYSTEMS DEPARTMENT

SANTA ANA, CALIFORNIA

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for economical JOB-SHOP RUNS...

The new **SIP HYDROPTIC** machine is faster in operation and response, more flexible, with greater machining capacity. In using a **HYDROPTIC**, the unique performance and guaranteed accuracy of positioning ensures economical production of normally expensive job-shop runs.

SIP

For information or nearest distributor, write to **AMERICAN SIP CORPORATION**

ONE HUNDRED EAST FORTY SECOND STREET, NEW YORK 17, N.Y.

- Operation Buck Rogers
- International Trade Wars
- Washington Briefs

Keeping up with Washington

Loring F. Overman

SHARING the Washington spotlight with electioneering are such topics as a ten-year space exploration program, international trade wars, and interim topics. The space program reveals several goals that might have been considered in a Buck Rogers column rather than worthy of inclusion in the *Federal Register*.

Importance of the space program to the machinery industries is the Aeronautics and Space Administration's estimate that within five years cost of the program will reach one billion dollars a year.

Recalling that the Government's atomic energy program will carry on during fiscal 1961 on a mere $295,000,000 budget, the magnitude of the expanding space program becomes apparent. The machinery industries will come in for a good portion of this huge sum, but must also share the problems of working with new substances that possess the ultimate in hardness and heat resistance.

Space program people no longer speak of their plans as possibilities. Instead, they ask, "When?" The following are samples of their estimates:

> Late in 1960, a man to make suborbital flight up 120 miles or so and back safely 200 miles at sea, the flight taking only fifteen minutes, reaching speeds up to 4000 miles an hour.
>
> In mid-1961, if all goes well with the suborbital flight, a manned orbital flight circling the earth two or three times before returning.
>
> Sometime after 1965, launching vehicles capable of carrying 50,000 pounds to the moon and placing a 150,000-pound space laboratory in earth orbit manned by several people.
>
> After 1970, if lunar experiments are successful, manned expeditions to greater distances, such as Venus, Mars, and other planets.

For each step of this almost-unbelievable program, those who machine and fabricate missile components must face overwhelming problems. The solutions, whether they involve a massive missile or a miniaturized electronic unit, may help manufacturers to solve the more earthly design problems they face today.

International Trade Wars

Any improvements that machinery people can suggest to cut rising production costs can be used as ammunition for the international trade wars which now seem to be brewing. With jet-plane transportation placing markets and deliveries within forty hours of almost any spot on earth, the old idea of business isolation is completely disappearing. Global planning is the new pattern for successful business.

To encourage greater interest in export markets, the Department of Commerce has completed formation of thirty-three regional export-expansion committees.

More than profits are at stake in the new global market trend, according to a recent report of the National Industrial Conference Board. The report observed:

> That the United States Government will have to give more importance to international considerations in framing domestic economy policies.
>
> That freeing of foreign currencies, the step-up in world trade, and the better competitive position of European producers have made the United States much more vulnerable to economic movements outside its borders.
>
> That this nation's multibillion-dollar export trade is entering a period of acute change as foreign producers duplicate our technical and mass production innovations—with their lower labor costs an added advantage.

Modernization of American plants through investment in new capital equipment, and investment in overseas production and distribution centers, are steps suggested. The modernization proposal is in line with the machine tool industry's premise that the first step toward increased economical production should be the acquisition of modern capital equipment.

Machinery manufacturers may be interested in suggestions made by returning export study missions; namely, American industry should redesign its products to meet overseas needs. Overpowered machinery, for example, is less welcome overseas than equipment meeting definite overseas standards. Overseas people prefer utility rather than gadgets—a lasting service rather than annual model changes. Similarly, a 12-cubic-foot refrigerator may be completely beyond the comprehension of an overseas customer. But a 3-foot model would be much in demand.

Washington Briefs

'Tween-season Washington, recovering from the Summit fiasco and awaiting election straws in the wind, busied itself with subjects such as these:

Business Statistics. A 1957-59 base period will be used wherever feasible, starting January, 1962, when statistical index numbers are published. Present base period is 1947-49. Federal Reserve Board has been using 1957 as its base for industrial reporting. Other agencies are changing to 1957 also.

1400 Planes a Year. Despite importance attached to missile projects, the Defense Department will purchase 14,000 manned planes in the next ten years, a DOD official indicated. The estimate noted that costs of Navy and Air Force aircraft have tripled—in some cases quintupled—in the past five years.

HARDINGE
ELMIRA, N.Y.

70th ANNIVERSARY 1890 - 1960 HARDINGE ELMIRA N.Y.

Model UM Universal Milling Machine

RESEARCH WORK *Demands* THE BEST IN MACHINE TOOLS

HARDINGE is the only manufacturer of companion precision machines for milling, straight turning, taper turning, boring, threading and facing with the feature of interchangeable collets, nose fixtures and attachments.

The Hardinge machines illustrated produce precision parts for working models. There are also three Hardinge precision production machines for high speed volume manufacturing—ask for details.

Model DV59 Precision Lathe

Model HLV High Speed Tool Room Lathe

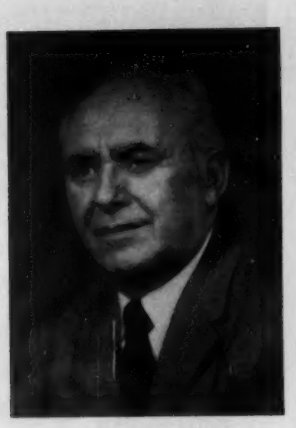
SPECIFICATIONS: *The UM Universal Milling Machine has cutter spindle and spiral dividing head collet capacity of 1-1/16" and a 25 x 6-1/2" swivel table. The DV59 Precision Lathe has 1-1/16" capacity and 9" swing with 17" between centers distance. The HLV Tool Room Lathe has 1-1/16" capacity and 11" swing with 18" between centers distance.*

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE

OFFICES IN PRINCIPAL CITIES. Export Office—269 Lafayette St., New York 12, N. Y.

Machinery
JULY 1960



IF...

IF it is true that we as a nation cannot have more things to use and enjoy unless we produce more, and that productive efficiency is an essential factor;

IF it is true that lower prices will benefit everyone, and that the only way to bring about lower prices, other than by the depression route, is through lower manufacturing costs made possible by higher productive efficiency;

IF it is true that to maintain high-level employment we must have high-volume sales which can best be assured by lower sales prices;

IF it is true that earning power depends on productive power and therefore increased productive efficiency provides the basis for maintenance of a rising wage scale;

IF it is true that the recorded results achieved by a considerable number of manufacturing concerns show that productive efficiency *can* be greatly increased;

IF it is true that there are serious obstacles which must be removed or substantially reduced before the rising trend in production efficiency can be substantially increased;

IF it is true that some manufacturers, a few labor unions, and some associations are doing what they can to reduce these obstacles but that no concerted nationwide effort is being made; and

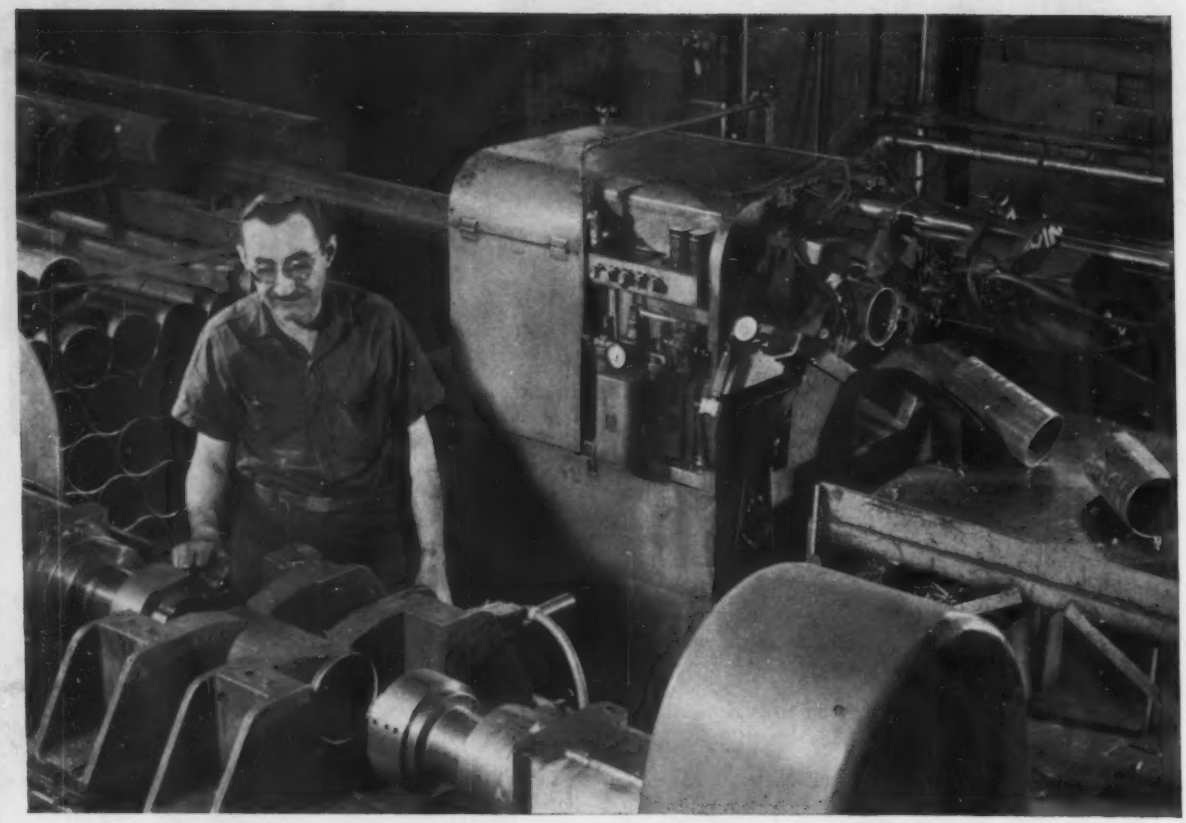
IF so much obviously depends upon productive efficiency and the maintenance of its upward trend,

WHY then, should not productive efficiency be given top rating, next to national defense, and be accorded utmost attention by the nation's leaders in industry, labor, and government?

Senator Jacob K. Javits of New York recently introduced in the Senate a bill intended to promote increased productivity in the national interest and foster peaceful labor-management relations through the establishment, in the executive branch, of a Bureau of Productivity Councils. This bill deserves the unqualified support of everyone concerned with the economic welfare of our country.

Charles O. Herb

EDITOR



Tubing for this job must meet the most rigid specs

This manufacturer of heavy-duty idler rollers has turned to increased automation and tighter material specs to improve production. Note automatic feed and cutoff of tubing in background . . . the quick setup for double-end counterboring at the next station.

Tubing for this job must meet highest standards for uniformity of size, straightness and close tolerance of concentricity. But where do you find large O.D. tubing to meet these rigid specs? At Ryerson, of course—home of the industry's tightest quality controls.

Here you choose from the nation's largest stocks. And you're assured of consistent quality that is so important to meet the demands of automation. The more automated your production line, the less chance for visual inspection, and the more dependent you are on the consistent quality of the raw material.

So when you next need tubing or help with selection and application problems, be "Metalogical"—call Ryerson.

The type of tubing you need is here

Carbon Steel Tubing—seamless and welded, round and square, cold drawn and hot finished.

Alloy Steel Tubing—seamless rounds.

Fluid Power Tubing—Rockrite cylinder finish, seamless and welded; hydraulic fluid line; seamless and welded cylinder tubing.

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Ledloy® 170 Tubing—fast machining, 170 sfm.

Stainless Pipe and Tubing—cold drawn seamless and welded. Also welded ornamental.

Aluminum Pipe and Tubing—all commonly used alloys and tempers.

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Machinery
Vol. 66 No. 11
July 1960

COLD-PRESSED BEARING RACES

EDGAR ALTHOLZ, Associate Editor

BAR STOCK REPLACES TUBING as the raw material for inner and outer races, which, for the antifriction-bearing industry, is a radically different manufacturing approach. Each slug sheared from the bars undergoes a series of cold-press operations: it is pancaked, cupped, and finally separated into an inner race and an outer race. Hardly any material is wasted.

Originator of this new technique is the Hyatt Bearing Division and the Process Development Section of General Motors. At its Clark, N. J., plant, Hyatt has set up two self-sufficient manufacturing areas with presses, heat-treating, and surface-preparation equipment. Already, the production of several popular size roller bearings has been completely converted to the process. Chief

advantage, say the developers, is that the bar stock costs considerably less than seamless tubing.

The transformation from slug to inner and outer race appears in the heading illustration. In the first press operation, the slug (1) progresses through two stations where it is squared (2) and pancaked (3). In the second press operation, the work-piece is backward-extruded or cupped (4). The third press has three stations which progressively upset the nose (5), pierce the bottom (6)—this small piece is scrap—and separate the work into an inner race and an outer race (7). Each race is coined in a final press operation, (8) and (9). Finishing operations on automatic chucking machines rapidly bring the work to size (10); then it is stamped, hardened, and finally ground (11).

Incoming stock consists of 20-foot long hot-rolled bars of 8620 steel. Fig. 1 shows the first step in the proccessing—shearing the bars to slugs of proper length. The bars roll one by one from an inclined rack onto the stock feeder seen in the foreground. These particular bars are 1 5/8 inches in diameter.

The stock is fed into the throat of the machine against a stop, and a die shears off thirty-five slugs per minute. From a discharge chute, the slugs are elevated by conveyor to an automatic weighing station, and from there, to tote boxes. Tolerance on weight is held within close limits.

Fig. 2 is a close-up of the third press operation. Incoming parts visible in the chute on the left are cup-shaped. Coated with a metallic soap solution, the parts appear white. Each cup slides down the chute to position in front of an air cylinder which pushes it back onto a shuttle. As the work progresses through the three die stations, it is nosed, pierced, and separated. Then the inner race drops through the die; the outer race, carried by the shuttle out the side of the press.

Another press operation, the coining of the outer race, is shown in Fig. 3. This view is the die area. Incoming parts in the chute seen in the foreground on the right drop onto an air-actuated shuttle and are indexed to position under a stripper plate. Inner races are coined in a similar press setup.

Same Intermediate Equipment Serves Entire Press Colony

During the change in shape from slug to bearing race, the metal is moved drastically, and work-hardens under the tremendous pressures involved. To restore plasticity, annealing is performed after each of the first three press opera-

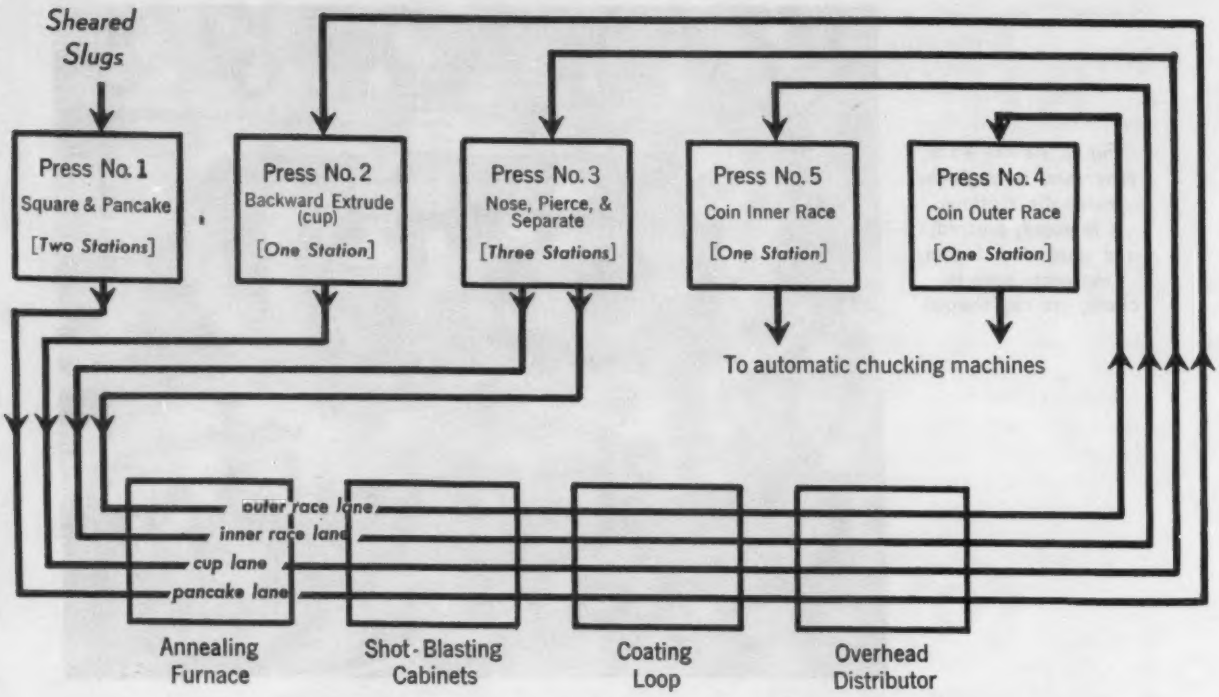
Fig. 1. In-plant processing starts by converting 20-foot lengths of bar stock to slugs of proper length on this shear.

Fig. 2. As the work progresses through the three die stations, it is nosed, pierced, and separated. Incoming parts, seen in chute, are cup-shaped.

tions. Each work-piece thus goes through three annealing cycles in its transformation.

But the annealing in turn leaves an unfavorable surface condition. Before the work moves to its next press operation, it must be thoroughly cleaned and coated. Undoubtedly, the most remarkable aspect of both manufacturing areas is the way the same annealing furnace, shot-blasting cabinets, and surface-coating loop have been integrated through an elaborate and entirely automatic material-handling system to serve all the presses.

Fig. 3. After the races are separated, they are again annealed, shot-blasted, and coated; then coined in a final press operation. This press is coining outer races.



Diagrammatic representation of the work flow shows how all five presses are integrated with the same intermediate processing equipment.

The view of the furnace entry (Fig. 4), for example, is dominated by four escalators, each bringing in work-pieces from the presses. Parts leaving the presses are discharged automatically into the bottom of the escalators. One escalator carries pancaked parts (detail 3 in the heading illustration) from the first press; another carries cupped parts (detail 4) from the second press; and the other two escalators carry the separated races (detail 7) from the third press.

Four belt lanes keep the parts separated as they traverse the continuous type furnace. Each escalator empties its contents into an oscillating bin which distributes the work evenly over the width of the respective belt.

Work remains in the first zone of the furnace about forty-five minutes, reaching a temperature of 1400 to 1425 degrees F. In the second zone, temperature is brought down to 1100 degrees F. in thirty minutes, then held there for another thirty minutes. When the work exits from the furnace, it is allowed to cool in air.

Still separated on their belt lanes, the parts advance to the shot-blasting equipment where scale and stains acquired in the furnace are removed. Each lane feeds its own compartment. When a predetermined number of parts have entered, load-sensing cells stop the feed, and shot blasting starts. Blasting medium is 0.023-inch steel shot. After a preset interval, the parts are discharged and the feed is resumed.

Phosphatizing Loop Cleans and Lubricates Work for Press Dies

Shot-blasted parts are conveyed to the cleaning and phosphatizing loop, a section of which appears in Fig. 5. Stainless-steel perforated drums loaded with the parts (handled in batches according to the four types) travel in unison around the loop in sixty-five-minute cycles. They are indexed with a series of processing tanks consisting of an alkaline cleaner, a cold-water rinse, a sulphuric-acid bath, a cold-water rinse, a hot-water rinse, a zinc-phosphate bath, a hot-water rinse, a neutralizing dip, and a metallic-soap bath.

Positioned over the tanks, the beams supporting the drums descend on their columns, and the drums start to rotate, exposing all part surfaces to the contents of the tanks. After a preset interval,

the beams move up, the drums stop rotating, then drain, and index around the loop.

Turntable of Unloading Station Directs Batches to Escalators

At the unloading station (occupied by the basket on the right in Fig. 5), the drums empty, ingeniously keeping batches separated. As each drum enters the unloading station, a tab carried on the outboard end of the drum's supporting beam trips one of four microswitches arranged vertically on a post at the station. This action energizes the motor of a turntable under a hopper into which the parts are dumped, orienting the turntable with one of four escalators leading to an overhead distributor. Each drum always takes the same kind of parts around the loop—either pancakes, cups, inner races, or outer races—and the tabs on the drum beams having the same assignment are all the same height, thereby tripping the same microswitch.

A view of the distributor appears in Fig. 6. This equipment has four separate storage bins to accommodate the cleaned and coated parts coming off the loop. Parts are fed automatically, on demand, into chutes leading to subsequent operations—the pancakes to the second press, the cups to the third press, and the inner and outer races to the fourth and fifth presses for coining.

Fig. 4. Four escalators bringing parts from the presses converge at the annealing furnace. Belt lanes keep parts separated according to type as they traverse furnace.

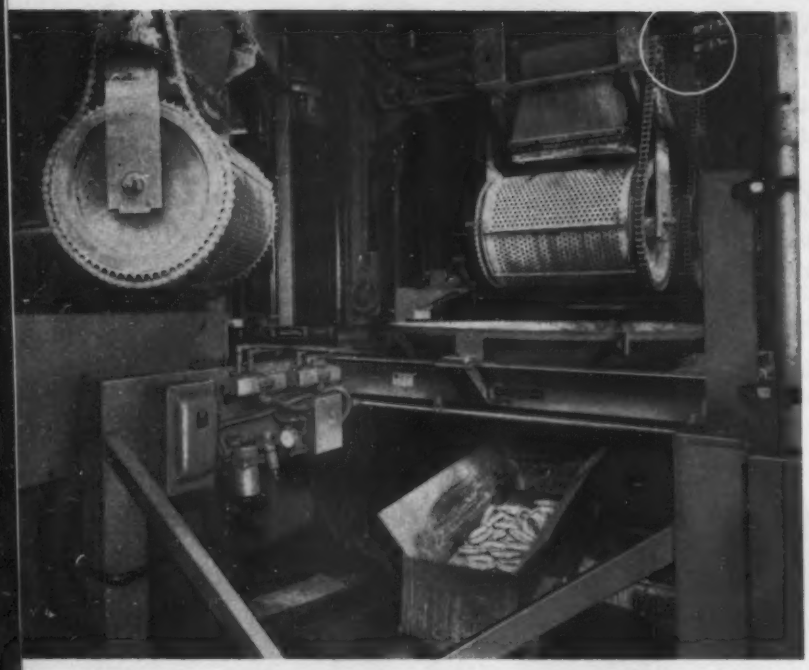


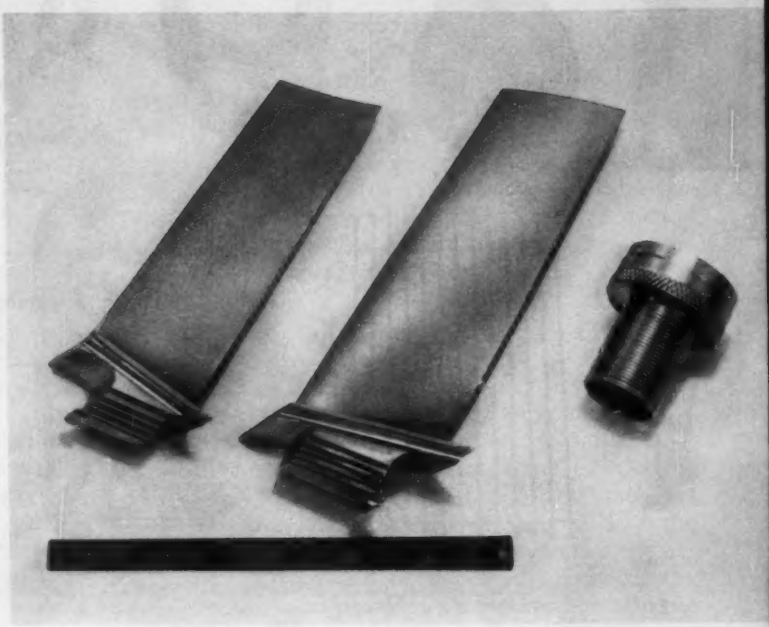
Fig. 5. Last stop around the loop for the drums is this unloading station. In encircled area can be seen how tab trips microswitch to orient turntable carrying discharge hopper.

The coining of the inner and outer races completes the press activity, and the work is directed to "captive" multiple-spindle chucking machines. Inner races are gripped internally while a single-point cam-controlled tool finishes the outside-diameter taper. Other tools face the work and produce grinding undercuts. Outer races are held externally and undergo similar operations. Parts leaving the machines are washed, pass through an automatic gaging and feedback station, then are stamped with the Hyatt name prior to hardening and grinding.

Fig. 6. Parts leaving loop travel to these storage bins; then, on demand, are distributed to chutes leading to subsequent press operations.

The process generally known as electropolishing has many unique applications, which include deburring and electro-machining. Often several operations can be eliminated and results improved by judicious use of the method

HAROLD W. BREDIN
Associate Editor



ELECTROPOLISHING... A Multipurpose Process

ESSENTIALLY the reverse of plating, electropolishing removes metal from the surface of parts electrochemically. Although the greatest use of the process at present is to obtain bright, smooth finishes on stainless steels, electropolishing has a number of other significant applications. Among these are deburring and electro-machining. The latter use is an extension of the process in which carefully controlled amounts of metal are removed from selected surfaces. Two compressor blades for a jet aircraft engine which have been electro-machined on the splined end to a tolerance of plus or minus 0.0001 inch are seen in the heading illustration. These blades and other typical parts electropolished by the Haward Corporation, North Arlington, N. J., are shown here to illustrate some uses of the process.

In electropolishing, the work-pieces are made the anodes (instead of the cathodes as in electroplating), and specially prepared electrolytes, generally composed of concentrated acid, are employed. When the proper voltage is applied across the electrodes, the metal removed from the parts by the electric current enters the electrolyte. Many of the electrolytes, including the Electro Glo solutions used by the Haward Corporation, allow the metal to settle out of solution and form a sludge of metallic salts. Such electrolytes have an indefinite life. The cathodes are made of lead, copper, stainless steel, or carbon.

The current distribution and, therefore, the metal removed are equal over the entire surface of parts except in small, deep holes and other relatively confined areas. To increase the rate of metal removal in these confined areas to a value approximating the rate obtained in exposed areas, special cathodes are often used that conform to the shape of the part.

Electropolishing Results in a Smooth, Nondirectional Finish

One important feature of the process is that the current density is greatest at the high points of a surface and metal is therefore removed from these peaks at a faster rate than from surrounding valleys or depressions. In this way, the peaks are progressively leveled, producing bright, nondirectional, and lower micro-inch finishes on the work. Except for the rounding of sharp edges and the smoothing of surfaces, the contour of the original part remains unchanged. Scratches made by grits

Fig. 1. (Left) With the exception of the strainer screen at the upper left, these stainless-steel parts were electropolished primarily to obtain a clean, smooth, and bright finish. The strainer screen was processed for burr removal and cleaning.

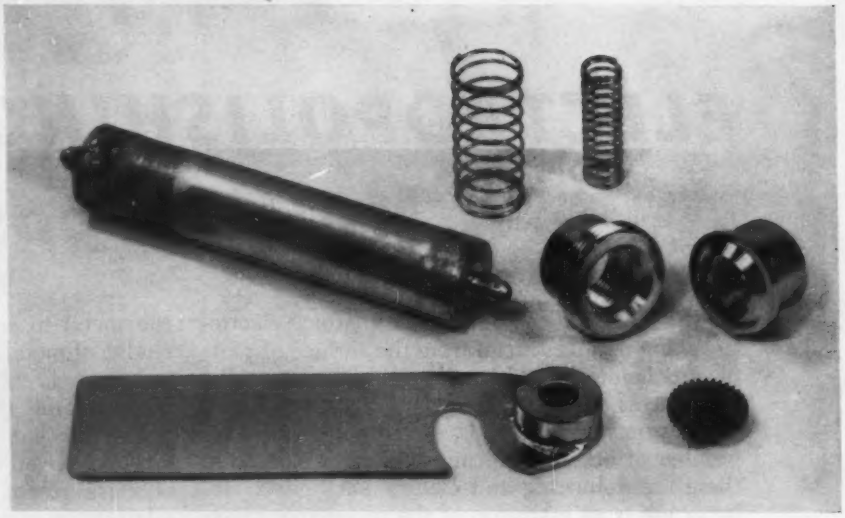


Fig. 2. (Right) Work-pieces that have been electropolished for various reasons, as follows: the two springs, for stress-relieving; the long cylindrical member, for cleaning and removing discoloration caused by silver-brazing (only partially electropolished); the steel gear, for deburring and smoothing of teeth and bore; and the two pipe fittings and the weldment (lower left), which are for milk-processing machinery, to provide easy-to-clean surfaces.

larger than 150 in size, however, may require excessive over-all metal removal.

In addition to producing smooth, bright finishes, electropolishing has a passivating effect on stainless steels, since nonmetallic materials that would otherwise tend to cause corrosion are removed by the process. For this reason and the fact that the brilliance imparted to stainless steels is retained, the most extensive use of electropolishing is in the finishing of work-pieces made of these metals. A number of stainless-steel parts that have been electropolished mainly for finishing purposes are shown in Fig. 1.

The use of electropolishing often allows stainless steels with less expensive initial finishes to be employed and permits subsequent finishing costs to be reduced. For example, when parts made from stainless steel having a Type 2B rolled mill finish are electropolished, the resulting surfaces most closely resemble a No. 7 mill finish but are nondirectional. An added advantage is that many fabrication marks and discoloration and scale caused by heat-treatment or welding are removed. Discoloration caused by silver-brazing of end caps was removed from a portion of the long cylindrical stainless-steel part seen in Fig. 2.

The nondirectional nature of an electropolished finish makes it particularly suitable for stainless-steel food- and milk-handling equipment, since milk and other foodstuffs do not adhere as firmly to such surfaces and are more readily removed in cleaning. Several of the electropolished parts shown in Fig. 1 are for soda-dispensing devices. Similarly processed pipe connectors and a weld-

ment that are employed as components of milk-processing machinery are seen in Fig. 2.

Other metals that can be electropolished include carbon steel, alloy steels, copper, copper alloys, nickel, nickel alloys, and wrought aluminum alloys. The surface produced on these metals is active in contrast to the passivating effect electropolishing has on stainless steels. For this reason, the process is often used to provide a good surface for plating. Electropolished steel parts will readily corrode unless protected in some manner.

Large grain size, nonuniform structure, and nonmetallic seams and inclusions in the metal are among the factors that will cause unsatisfactory results. For example, seams, stringers, and nonmetallic inclusions become visible in an electropolished surface. In general, poor materials or workmanship are revealed by the process.

Because sharp, raised portions of a surface are removed at a faster rate than the surrounding metal, the process can be used for deburring. The more intricate the part, the more economical becomes deburring by this method. It will remove burrs almost regardless of their location or the shape of the part. In addition, the process will not miss burrs and each part can be deburred to the same degree while holding critical tolerances. Stamping and drilling burrs up to 0.010 inch thick can be removed by electropolishing.

A typical group of parts that have been deburred by this method are shown in Fig. 3. At the bottom of the illustration is a strip of electrical contact springs stamped from beryllium copper. In removing the stamping burrs from this strip, a tolerance of plus or minus 0.0005 inch on the thickness of the springs was maintained. Another example of deburring is the commercial gear seen at the lower right in Fig. 2. The process not only deburrs the gear teeth but also deburrs the bore and improves the surface of both the bore and the teeth. After electropolishing, these gears, being steel, are coated with oil to prevent corrosion.

By masking surfaces and carefully regulating the current density and processing time, the amount of metal removed from selected surfaces can be controlled to within 0.0001 inch. When the process is used to size a part in this manner, it is often called electro-machining.

Examples of electro-machining are the two blades for the compressor section of a jet aircraft engine seen in the heading illustration. A number of these blades, which are made of Type 403 stainless steel, were electro-machined on the splined end to within plus or minus 0.0001 inch. Before processing, they varied between 0.003 and 0.007 inch oversize. Shown at the right in the heading illustration is an electronic connector that was electropolished to remove 0.007 inch on the bore. In addition to finishing this bore, the threads of the connector were made smooth and machining burrs were removed.

Versatility an Important Feature of Process

An illustration of the versatility of electropolishing is the sewing machine part seen in Fig. 3 (third piece, middle row). On this stamping from Type C 1010 steel a hole was deburred and the part was cleaned in preparation for chrome- and nickle-plating. Plating repeats the finish of the base metal. Thus electropolishing not only deburrs this part and improves adherence of the plating but also provides a smoother finish on the resultant plated surface.

Electropolishing was used to stress-relieve the springs shown in Fig. 2. Scratches in the surfaces of these springs—potential points of stress concentration—were removed, thus extending their fatigue life an estimated 30 to 50 per cent.

Another interesting application of electropolishing involved the production of a battery case for a missile. The case, which was required to have a certain weight, was made heavier than desired and then electropolished all over until the exacting weight specification was met.

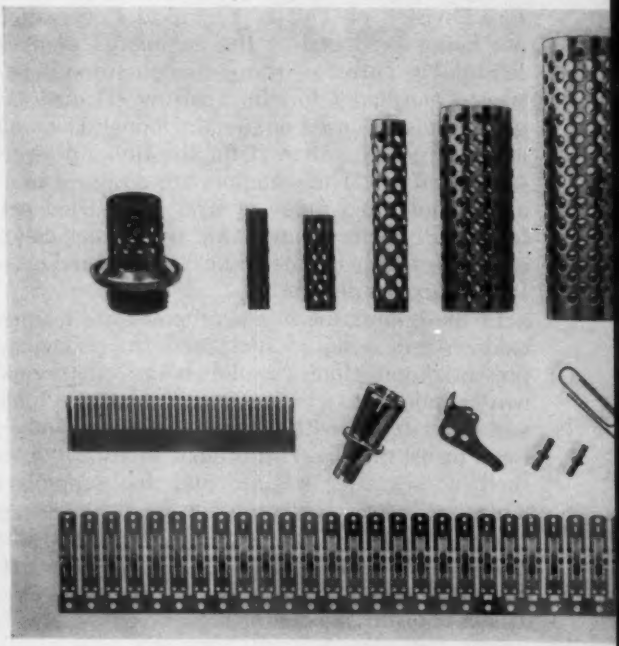
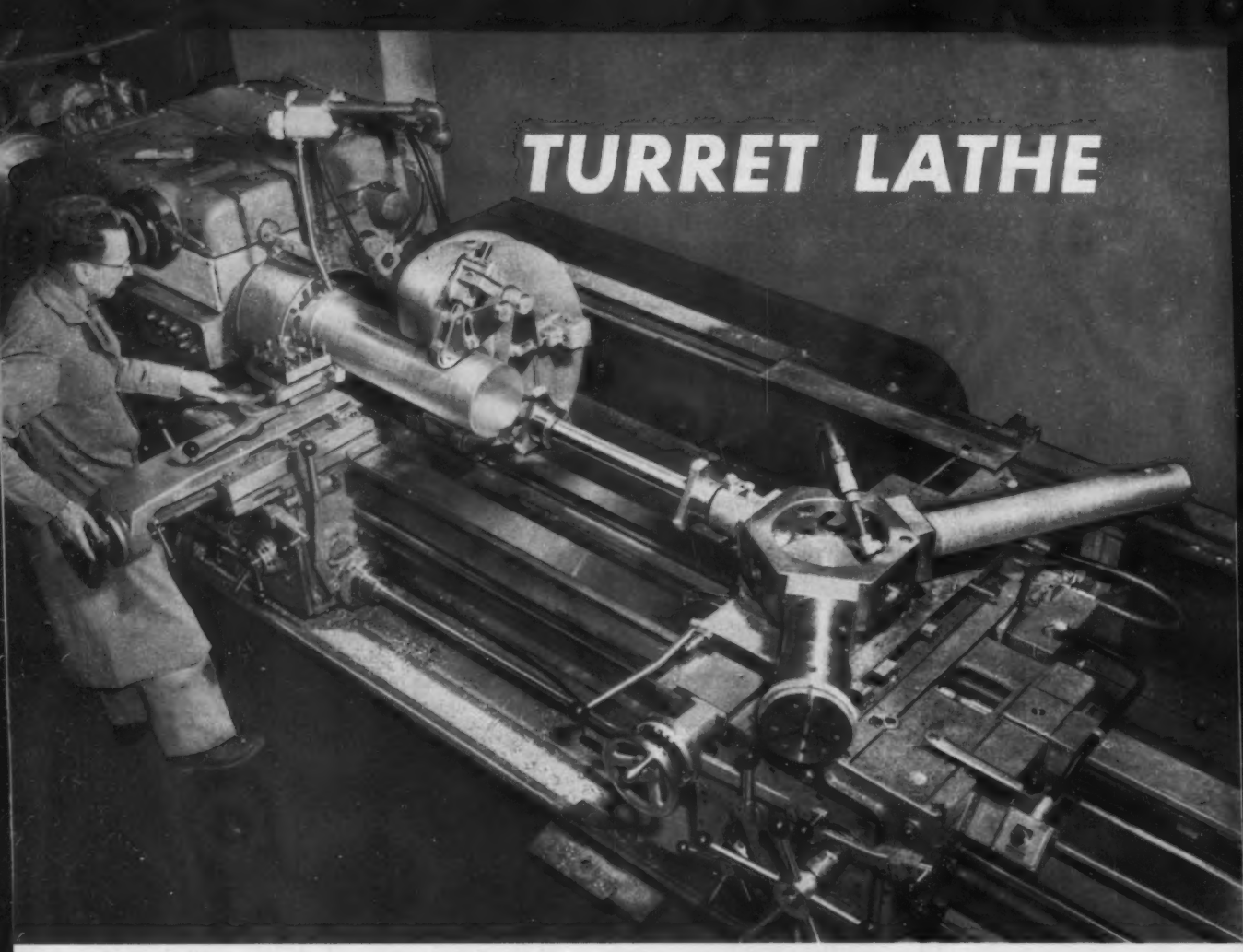


Fig. 3. Here are a number of parts electropolished to remove burrs. Paper clip is for size comparison. Materials represented are stainless steel, beryllium copper, and machine steel. Third piece in second row is a stamped steel sewing-machine part which was processed for deburring and to prepare surfaces for plating.



PREPACKAGED liquid-propellant rocket-thrust units, newly developed by the Reaction Motors Division of Thiokol Chemical Corporation, are being produced at the company's plant in Bristol, Pa. Thrust units are manufactured in two sizes: Guardian I for the Sparrow III air-to-air guided missile (used on the McDonnell Demon), and a larger Guardian II for the Bullpup air-to-surface missile. These engines are designed in an almost unlimited range of sizes and varied performance specifications. (One such specification called for a large engine in the 50,000-pound class. It was successfully fired.)

In these units the liquid propellants (a liquid oxidizer and a liquid fuel) and the propellant pressurizing medium (a solid charge) are permanently sealed into a high-strength aluminum tank, which is integral with the rocket-thrust chamber. Each thrust unit has two tubular shells: an outer shell houses the oxidizer and fuel-propellant tanks; an inner shell contains a pressurizing-charge tube, a center header, and the thrust chamber. The center header separates the oxidizer and fuel compartments; it also contains a cluster of orifice injector fittings.

Attachment threads, launching lugs, and fin attachments connect the power plants to the missile. To fire, no pumps, shafts, valves, or similar moving parts are used. Instead, the power plants supply electrical energy to initiator cartridges.

Because of these all-welded power plants, many advantages of liquid propellants can be maintained. No countdown or other preparation period is required because propellants are inert until mixed and ignited by the power plants. Another advantage is that the units can be handled in the field just the same as solid-propellant rockets—either firing them immediately or storing them for long periods.

Except for a forged, copper-alloy chamber nozzle and one part made from a 3-inch diameter bar of AISI 4130 steel, all components of the rocket-thrust units are made from forgings or extrusions of 6066-T6 aluminum alloy. This metal, a development of Harvey Aluminum, is supplied to Thiokol by Alcoa in the T4 condition. Aluminum alloy was selected because of its tensile strength (ultimate is 50,000 psi), corrosion resistance, and its good machinability and good weldability.

The oxidizer tank head (at front of power

CONTOURING OF PARTS FOR ROCKET ENGINES

CHARLES H. WICK

Production of prepackaged, liquid-propellant, rocket-thrust units demands the use of versatile machines which can easily be retooled to handle different parts or components of modified design. Here is how aluminum extrusions and forgings can be quickly contour-turned and bored on turret lathes with hydraulic tracers

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plant) and the boattail fairing are machined from forgings; the uniform cylindrical sections of the oxidizer and fuel tanks are machined from extrusions. The thrust chamber consists of a thin, aluminum-alloy cooling jacket over a machined aluminum-alloy forging.

Machining of the forged and extruded thrust-unit components consists mostly of contour-turning and boring, facing, cutting off, grooving, and chamfering. Roundness and wall thickness on most parts are critical, with tolerances maintained within 0.005 inch—sometimes as close as 0.002 inch. Careful weld-joint preparation is essential as is the all-over surface finish.

Requirements that had to be met in setting up low-volume production facilities for the prepackaged, liquid-propellant, rocket-thrust units included: rapid delivery of the manufacturing equipment; economy of equipment to provide low cost per unit; machine versatility to permit fast retooling for handling different parts or components of modified design.

These requirements were met by specifying standard turret lathes which could be quickly and simply set up to produce various work-pieces. For contour-turning and boring, the lathes are equipped with hydraulic tracing attachments using flat templates. The flat templates are easily made and require minimum storage space.

Oxidizer tanks, made from aluminum-alloy extrusions, approximately 8 inches in diameter by 27 inches long, are contour-bored, faced, chamfered, and turned on the Gisholt saddle type turret lathe (heading illustration). One end of the tubular extrusion is held in a 12-inch capacity, three-jaw, air-operated chuck. The other end is supported by an expanding mandrel on a live center that is mounted on one of the faces of the hexagon turret. The tank is supported by an open-side steadyrest mounted on the rear way of the turret lathe.

Approximately 1/4 inch of stock is removed from the oxidizer tank's periphery and bore in this setup; the over-all length of the extrusion is reduced about 2 1/4 inches. The speeds and feeds, typical of those used for all turret lathe operations described here, vary from 500 to 1300 surface feet per minute at 0.006 to 0.015 inch feed per revolution. Carbide tools are used for most operations, with high-speed steel tools reserved for grooving and parting. Surface finishes range from 16 to 125 micro-inches.

A soluble oil coolant, mixed with water in a 1 to 15 ratio, is used. For contour-boring, the coolant is supplied through the hollow boring-bar from an automatic distributor mounted on the rear of the hexagon turret. Forward movement of the turret automatically opens a coolant supply valve; re-

Fig. 1. Extruded aluminum oxidizer tank liners are contour-turned on this turret lathe with hydraulic tracer.

Fig. 2. Flat template seen at lower right controls contour in boring oxidizer tank and ring assembly. Stylus is at rear of hexagon turret.

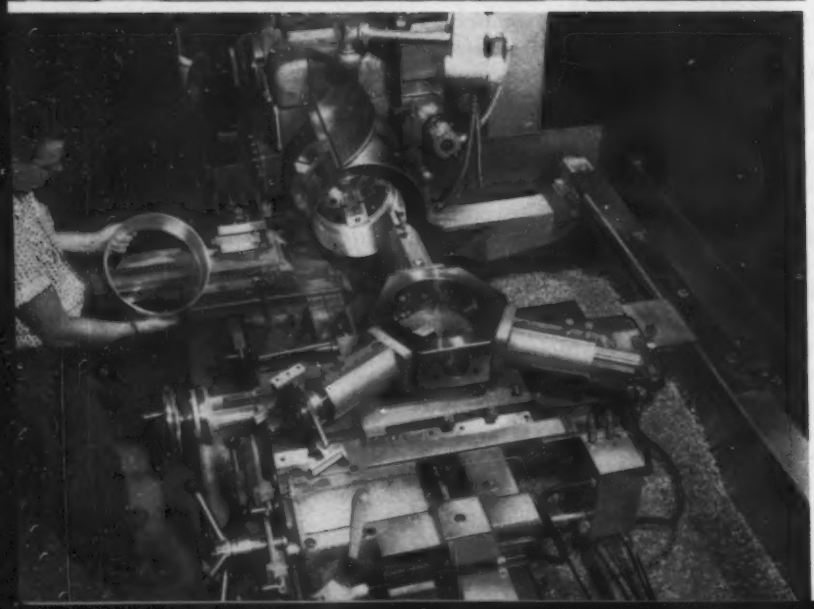


Fig. 3. Fuel tanks for prepackaged, liquid-propellant, rocket-thrust units are contour-bored, faced, chamfered, and turned in the setup illustrated.

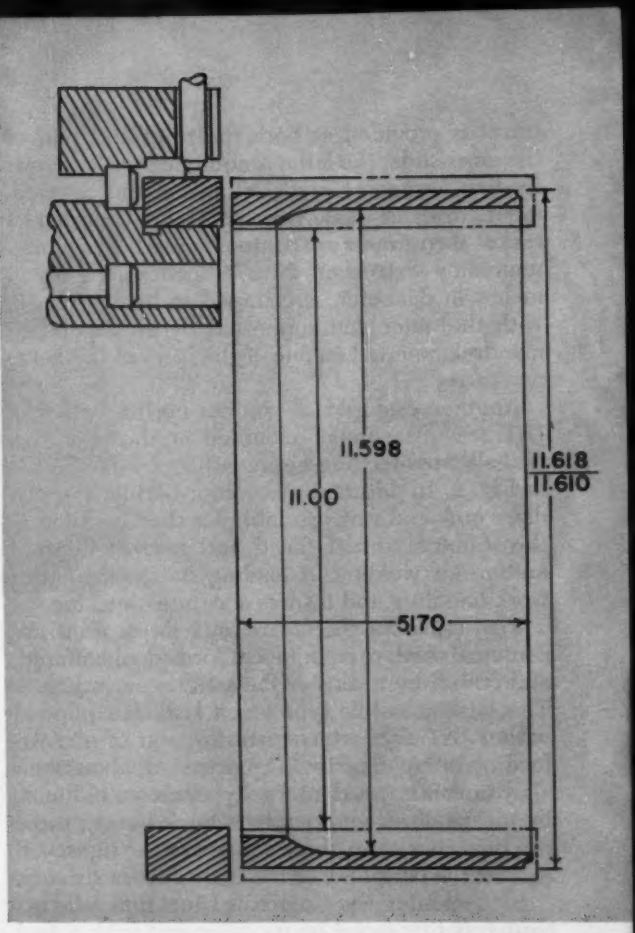


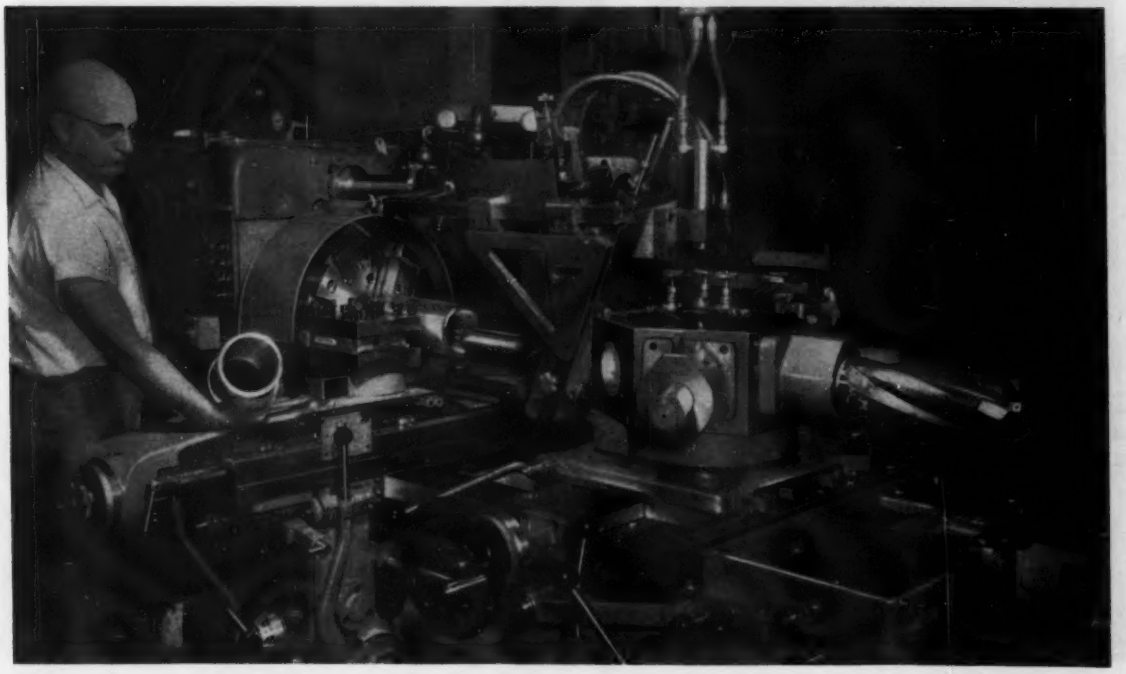
Fig. 4. Method of chucking the extruded, aluminum-alloy fuel tank for the operation seen in Fig. 3. Set-screws around the periphery serve to drive the work.

turn of the turret closes the valve. The soluble oil has a wax base to improve surface finish. This requires degreasing of the parts immediately after machining. As the completed oxidizer tank is parted from the extrusion stub (retained in the chuck), it is supported by a catch-bar projecting from one of the faces on the hexagon turret.

Contour-boring of the oxidizer tanks is done by a cross-feeding hexagon turret and JETracer attachment on the Gisholt machine. This arrangement makes possible four-way feed motion of the hexagon turret. The high-pressure hydraulic JETracer consists of a separate slide and control unit mounted on the hexagon turret. It is actuated by a stylus following a flat template mounted at the back of the machine. Movement of the stylus changes the pressure balance in the tracer unit, causing the slide to move in the same direction as the stylus. Oil is supplied to the JETracer from a tank equipped with both high- and low-pressure pumps.

On the Gisholt saddle type turret lathe, seen in Fig. 1, the JETracer is attached to the rear of a bridge type cross-slide. A quick-indexing, square

Fig. 5. Hydraulic tracer attachment is mounted on a hexagon turret face for contour-boring of aluminum combustion chambers.



turret is provided at both the front and rear of the cross-slide; the lathe is equipped with a cross-feeding hexagon turret. Because of this arrangement, oxidizer tank liners for the Guardian I rocket-thrust units are contour-turned. The aluminum-alloy extrusion, 26 3/4 inches long by 4 inches in diameter, is clamped in by the chuck, with the outer end supported by an expanding mandrel mounted on one of the faces of the hexagon turret.

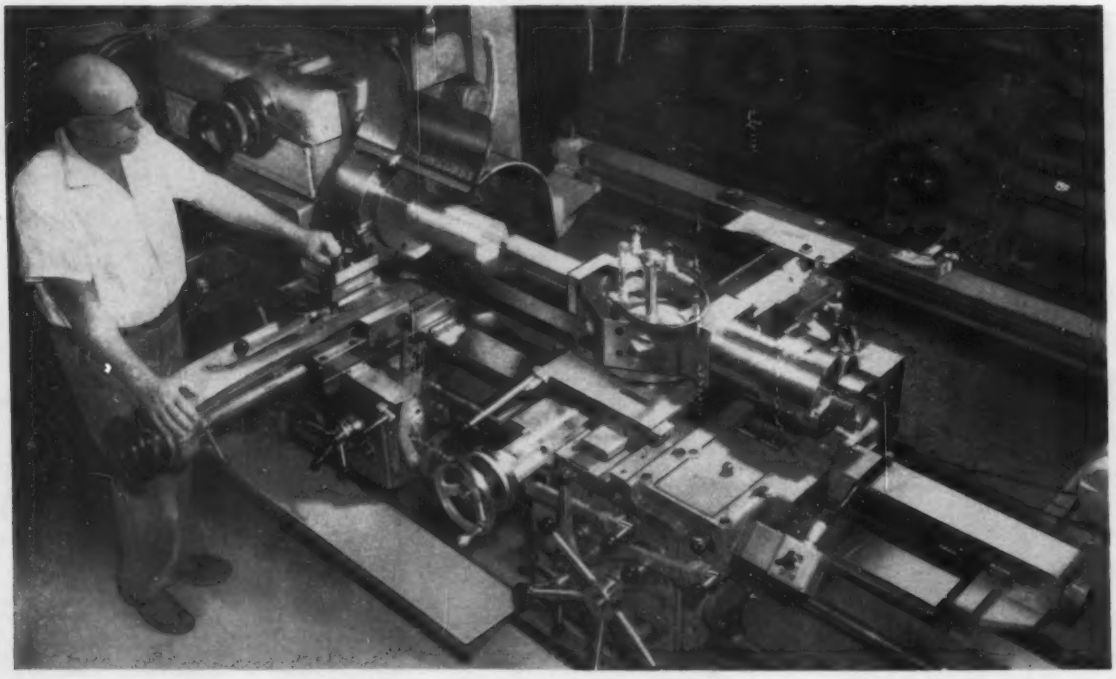
Another example of contour-boring with the JETracer attachment mounted at the rear of a Gisholt cross-feeding hexagon turret is illustrated in Fig. 2. In addition to contour-boring, the oxidizer tank and ring assembly for the Guardian II thrust unit is turned, faced, and grooved in preparation for welding. A loading station facilitates work-handling and insures accurate chucking.

Fuel tanks for the Guardian I thrust units are contour-bored, turned, faced, formed, chamfered, and cut off by means of the setup seen in Fig. 3. This Gisholt saddle type turret lathe is equipped with a JETracer attached to the rear of a cross-feeding hexagon turret. The extruded, aluminum-alloy tank is gripped internally, as shown in Fig. 4, by means of an air-operated chuck having three rim type jaws. Also, three set-screws are tightened against the periphery of the extrusion for driving.

In machining the Guardian I fuel tank, the extrusion is first faced on its outer end with a tool mounted on the quick-indexing, square turret at the front of the cross-slide. Then, the straight portion of the tank bore (11 inches in diameter) is finish-bored with a boring-bar mounted on one face of the hexagon turret. Next, the periphery is rough- and finish-turned, using tools on the cross-slide square turret. Contour-boring is completed in three cuts with the boring-bar on the hexagon turret and the JETracer attachment. A tool on the cross-slide is used to form the concave-shaped chamfer on the outer edge of the tank. Finally, the tank is cut off from the extrusion stub with a cross-slide square turret tool. A projecting catch-bar from one of the hexagon turret faces holds the part until it is manually unloaded.

Core-drilling, contour-boring, facing, chamfering, and turning of the combustion chambers for Guardian I rocket-thrust units are performed on the Gisholt turret lathe seen in Fig. 5. The chambers, 12 3/4 inches long by 5 7/8 inches in diameter, are made from aluminum-alloy extrusions. An 18-inch, air-operated chuck is used to hold the chamber during machining, locating from the rear face of the extrusion. In this application of contour-boring, the JETracer slide and control unit are mounted on one of the hexagon turret faces. The tracer template is held in a sliding bracket that locates for length on an adjustable bracket attached to the overhead pilot bar. Forward feed of the saddle causes the tracer stylus to

Fig. 6. Both turning and boring operations are accomplished in this setup by using the taper attachment and a tracing unit.



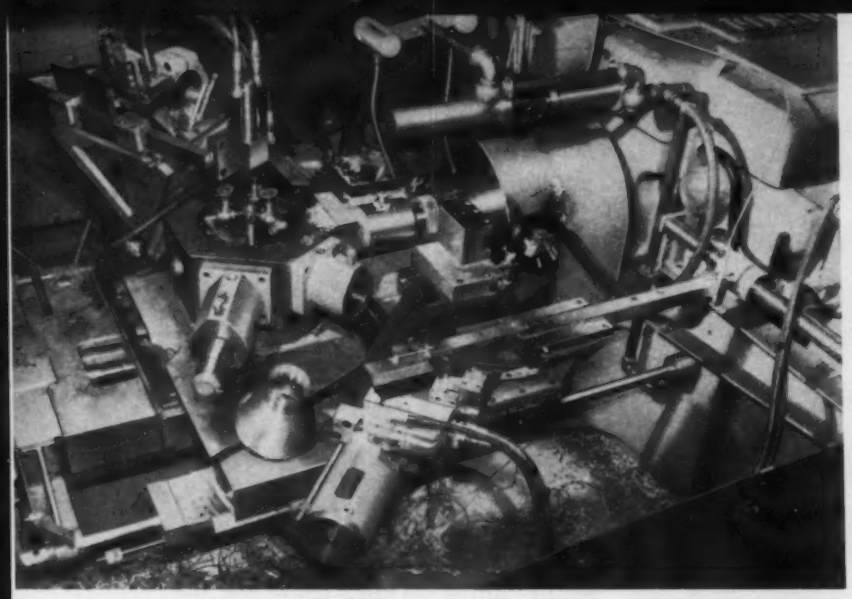


Fig. 7. Two tracing attachments are used on this lathe: the one on the cross-slide is for turning; the other, on the hexagon turret, is for boring.

follow the template contour which governs movement of the boring tool on the tracer slide.

Combustion chambers for Guardian II rocket-thrust units are both contour-bored and taper-turned, as well as faced and chamfered, on a Gisholt turret lathe, Fig. 6. The extruded aluminum-alloy chambers, 5 3/8 inches in diameter by 12 1/4 inches long, are held in a 15-inch chuck. A JETracer attachment is connected to the rear of the cross-feeding hexagon turret for contour-boring the chambers. Taper-turning of the outside diameter is accomplished with a cross-slide taper attachment equipped with a special-angle cam. Two cuts are made for both contour-boring and taper-turning. The floor-to-floor time is 14 1/2 minutes for each combustion chamber.

Forged, copper-alloy chamber nozzles are contour-turned and bored, faced, and grooved on the Gisholt turret lathe seen in Fig. 7. In this instance, the lathe is equipped with two JETracer attachments—one on the rear of a bridge type cross-slide for contour-turning, and the other on one of the hexagon turret faces for contour-boring.

After facing one end of the forging with a tool mounted on the quick-indexing, square turret at the front of the cross-slide, the part is bored with a boring-bar mounted on one face of the hexagon turret. A supporting mandrel on the hexagon turret is inserted, then expanded in the bore of the work-piece; the nozzle is contour-turned by the JETracer on the rear of the cross-slide. Tools mounted on the cross-slide square turret form

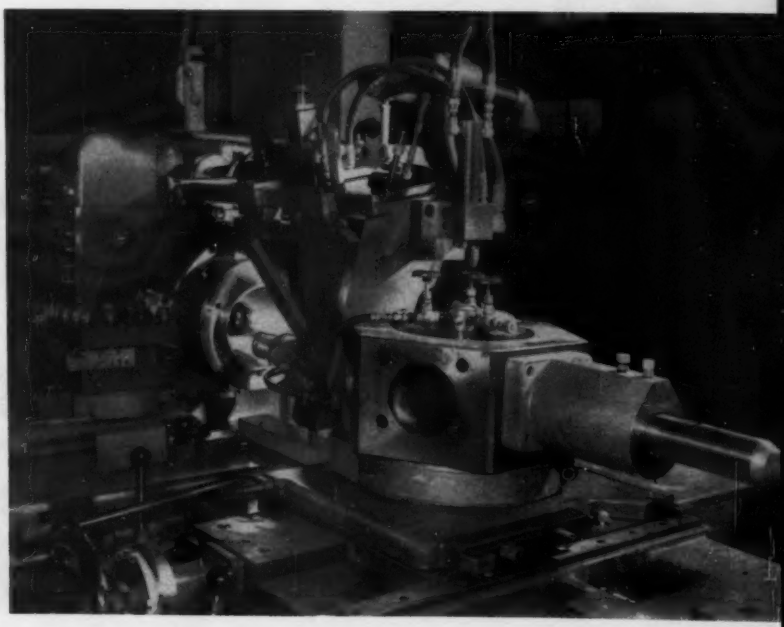


Fig. 8. Forged, copper-alloy chamber nozzles are finish contour-bored on this turret lathe. Tracer attachment is mounted on hexagon turret.

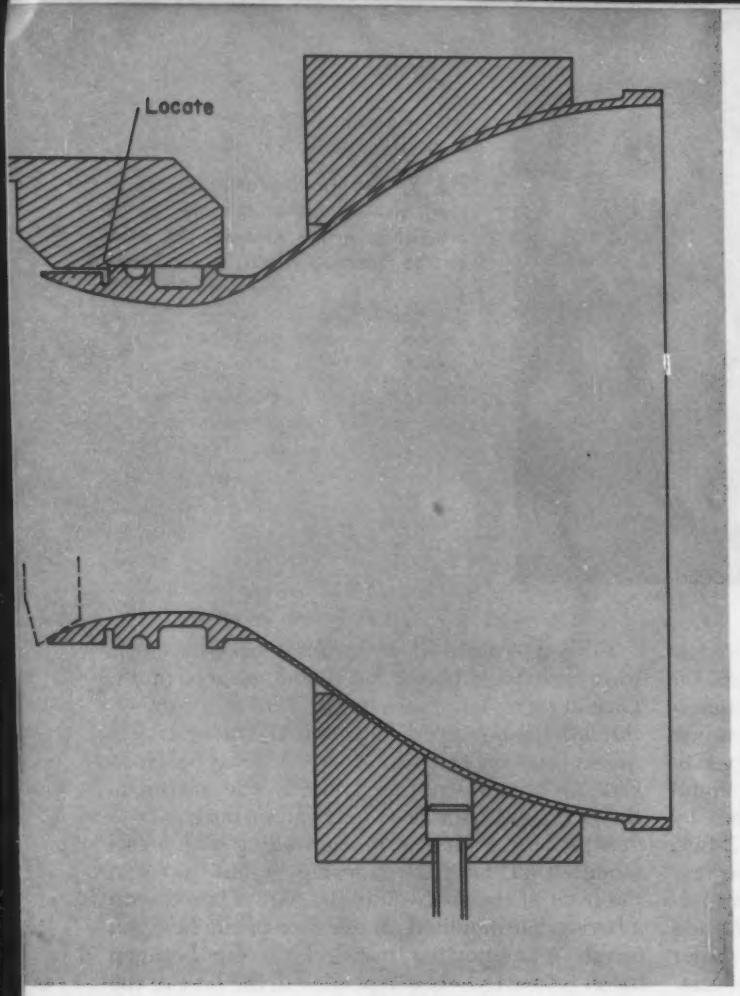


Fig. 9. Pusher mounted on hexagon turret of lathe seen in Fig. 8 is used to press chamber nozzle against a centralizing ring.

grooves in the forging. Withdrawing the mandrel, the chamber nozzle is rough contour-bored by the JETracer on the hexagon turret, completing the machining of the nozzle on this lathe. It is manually unloaded from the chuck.

Finish contour-boring of the chamber nozzle is performed on another turret lathe, Fig. 8, having a self-contained JETracer slide-tool mounted on one face of the cross-feeding hexagon turret. In loading the three-jaw chuck, the nozzle is pressed against a hand-locked, centralizing ring, Fig. 9, with a pusher mounted on the hexagon turret.

Mounting cones for the Guardian I rocket-thrust units are aluminum-alloy forgings. On the Gisholt saddle type lathe (Fig. 10), parts are bored, faced, and contour-turned, including interrupted tracing of the faces on the four fins. The JETracer attachment on this machine is mounted on the rear and controls transverse movement of the cross-feeding hexagon turret for the contour-turning operation.

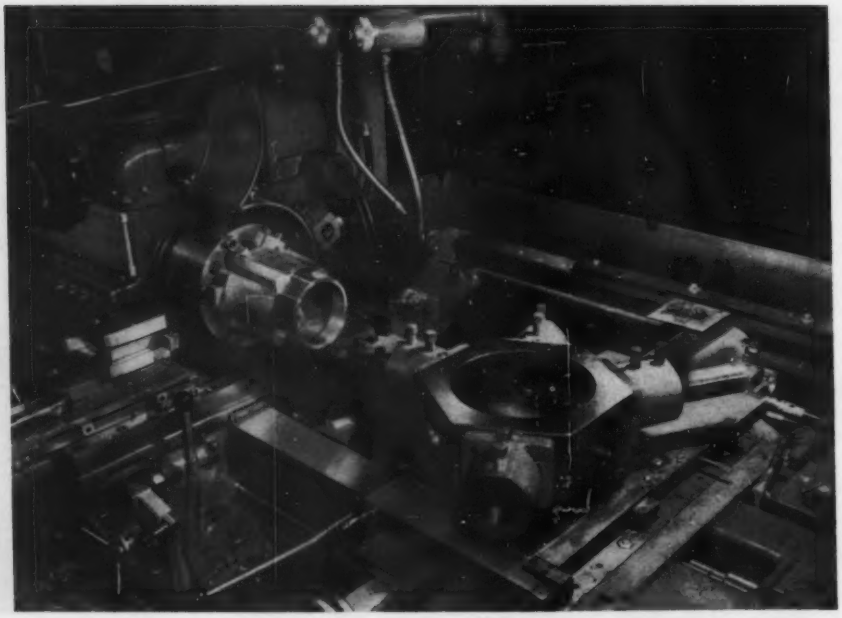


Fig. 10. Hydraulic tracing attachment is mounted on rear of cross-feeding hexagon turret for contour-turning of cones.

BUILDING THE ELECTROLUX VACUUM CLEANER

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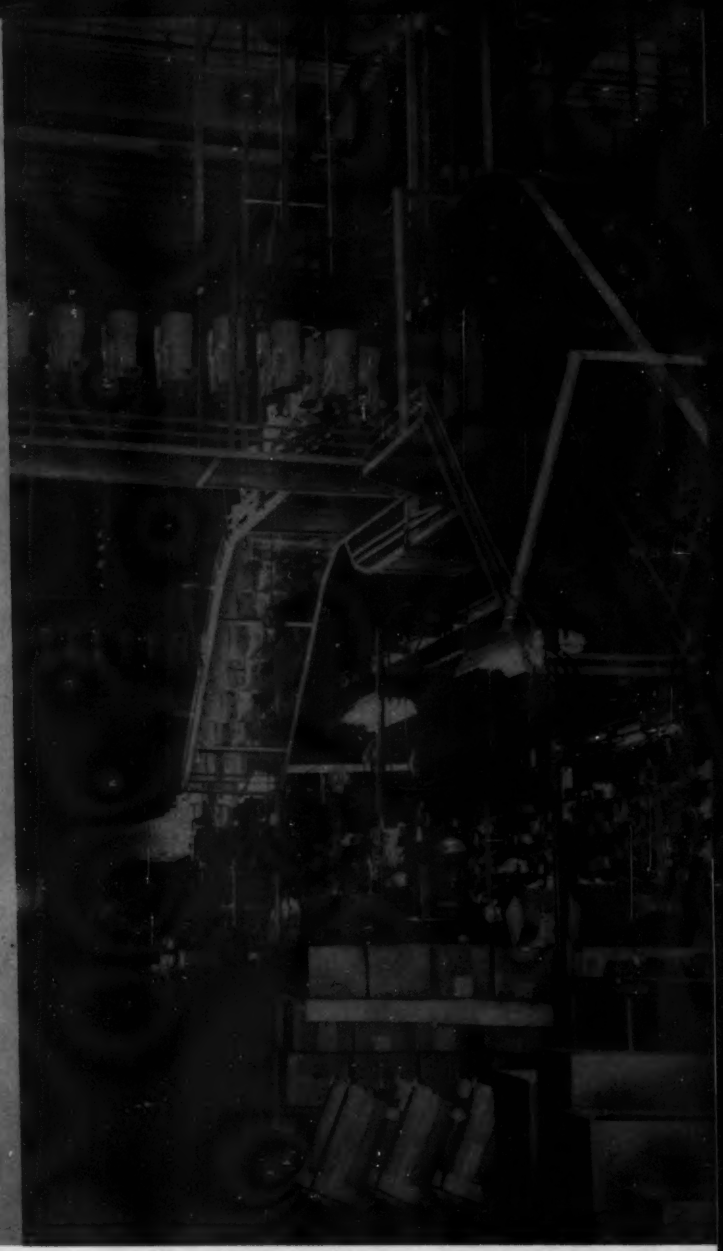


WHEN THE ELECTROLUX CORPORATION pioneered the tank type vacuum cleaner thirty-five years ago, domestic science underwent a little "Industrial Revolution" all its own. With its hoses, wands, and various attachments, the new units cleaned not only the housewife's rugs, but also her walls, woodwork, draperies, and upholstery; and, in addition, sprayed paint, moth repellent, and deodorizers. Successful from the start, Electrolux claims title to the Number One sales spot in the industry, and takes pride in its well-integrated plant in Old Greenwich, Conn.

Recently, a turbine-driven power unit, the Turbotool, was put on the market as an attachment to the vacuum cleaner for polishing floors, shampooing rugs and carpets, and even for driving small power tools. Many of the vacuum cleaners are equipped with a new type cord winder which the company started making recently. Even with the addition of these new products, the high volume is in vacuum cleaners. This is reflected in the mass-production techniques employed, such as the conveyorized assembly department seen in the heading illustration.

A high degree of efficiency has been obtained in a variety of machining jobs by unique groupings of self-contained drilling units. One of the setups appears in Fig. 1. Here, a die-cast alumi-

num housing for the cleaner motor undergoes a series of milling, drilling, and tapping operations. Seven Kingsbury heads run simultaneously.

One head, positioned vertically, drives a hollow mill which cleans up a bearing cap boss on the end of the housing. There are two banks of three heads each, one above the other, disposed horizontally. The heads in each bank are located radially around the frame, 120 degrees apart.

The top bank drills six holes—two apiece—which are subsequently tapped when indexed to the bottom bank. These holes are used to fasten the motor to mounting brackets inside the cleaner. Two housings are worked on in each cycle: while the work-piece in the top bank is being drilled and hollow-milled, the previous work-piece, now in the lower bank, is being tapped. (Heads in the lower bank are the reversing type.) Cycling is automatic, and the role of the operator is limited to positioning the housings in the banks.

Self-Contained Units Cut Labor Factor

Actually, the drilling and tapping of the holes are distinctly separate operations and could have been handled in two different setups. By employing self-contained units, the two have been combined in one compact setup, requiring the services of only one operator. Except for a simple supporting fixturing, no special-purpose equipment has been needed.

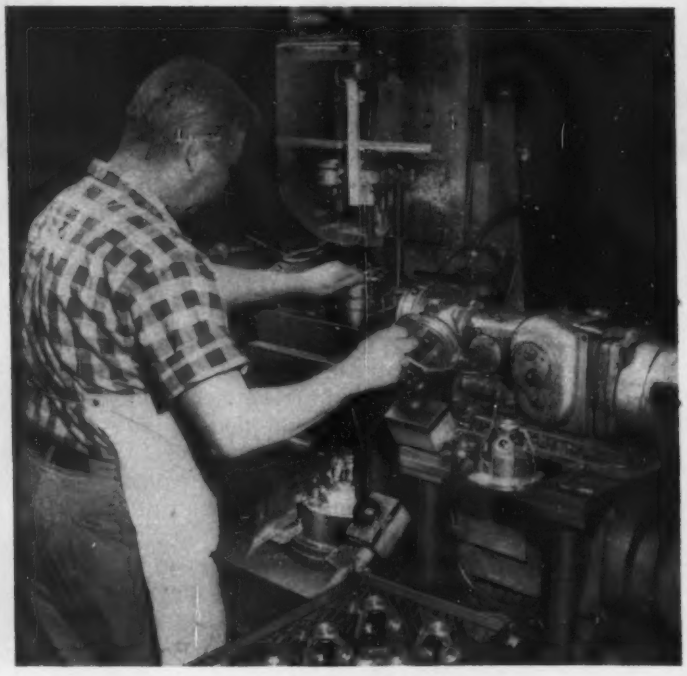
The same principle has been applied in a subsequent set of operations on the motor housing, Fig. 2. In this instance, five Kingsbury heads are involved. A vertical head performs a drilling step in conjunction with a bank of two horizontally opposed heads which tap cored holes in the housing. When indexed to a second bank of heads beneath the first, the housing's two brush-holder holes are bored, spot-faced, and chamfered.

Another effective use of self-contained units can be seen in Fig. 3, where one man services two unrelated setups for machining components of the vacuum cleaner's cord winder. In one setup (behind the operator), two blind holes are tapped in the die-cast aluminum cord-winder cover half. The operation is performed by two reversing heads set vertically on a table.

In an automatic cycle controlled by push-buttons, the cover is clamped by an air cylinder; the taps feed and reverse, and the cover is then unclamped. A mist-lubrication system operates

Fig. 1. The seven self-contained units process two motor housings simultaneously. While one work-piece is drilled and milled by the top bank, the preceding work-piece is tapped by the lower bank. Vertical head operates in conjunction with the top bank.

Fig. 2. These two banks consist of two opposed heads each. Vertical head drills the work-piece while the top bank taps cored holes in the motor housing. Brush-holder holes are processed when the work-piece is indexed to the lower bank.



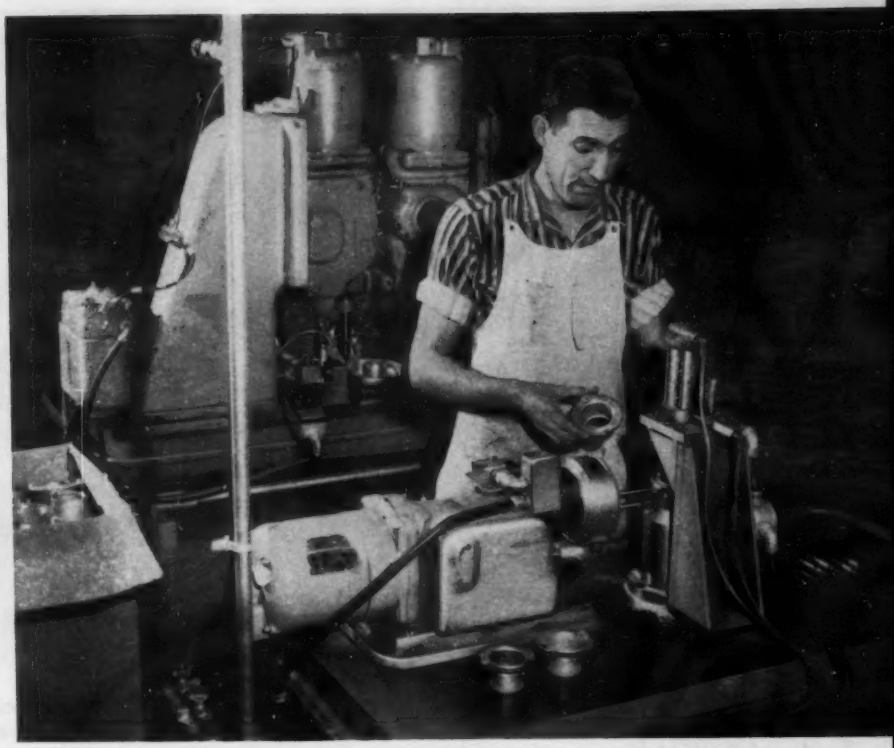


Fig. 3. With automatic clamping and unclamping interlocked with the cycling of the heads, one operator is able to service two unrelated setups on cord winders.

Fig. 4. Each of the two machine spindles carries a pot type fixture for one of the cord-winder cover halves. Mist-coolant system, seen on right in foreground, is synchronized with the machine cycle. Finger clamps around fixtures are air-operated.

automatically with the feed stroke. During the cycle, the operator is free to service the other setup (seen in front of him).

Here, two small holes are drilled in the wall of the cord-winder reel hub. A multiple-spindle attachment is used with the self-contained unit. The work fixture (seen on the right) has an integral air clamp which is interlocked with the cycling of the head.

Both halves of the die-cast cord-winder cover are bored and faced simultaneously on the Ex-Cell-O dual-spindle machine in Fig. 4. Each spindle carries a pot type fixture. Finger clamps around the fixtures are air-operated. Once the spindle drive is energized, the table feeds hydraulically. When the table retracts, the spindles stop and automatically unclamp the work. A mist-coolant system is synchronized with the machine cycle.

To process an elbow adapter for a rug-cleaning tool, a Kingsbury head is positioned vertically on a table near a two-spindle Ex-Cell-O boring machine. Both appear in Fig. 5. The head, equipped with a multiple-spindle attachment, simultaneously drills two rivet holes in two work-pieces. On the table are two horizontally opposed cylinders which operate the clamps of the work fixtures. Clamping is automatic, and is synchronized with the feed of the head.

At the end of the cycle, the operator extracts

Fig. 5. Elbow adapters receive rivet holes on the vertical head (in front of the operator), then are transferred to the boring machine (right), where they are faced, bored, and back-faced.

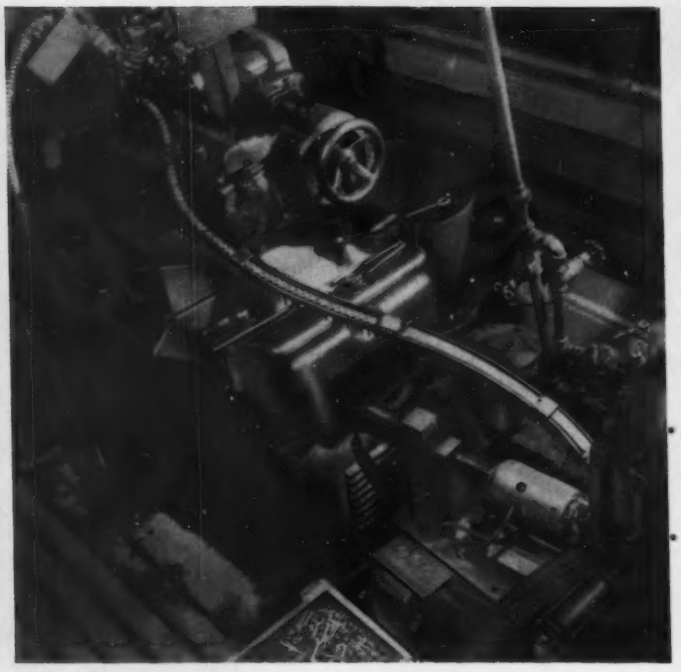


Fig. 6. The screw machine turns and knurls valve stem, presses bonnet over stem, and cuts off the assembly to length. Unit in foreground cross-drills apertures in stem and scribes witness mark on bonnet.

Fig. 7. Wand lengths are rapidly sheared to length without loss of material by the shimmy die of the cutoff machine. A carriage automatically advances stock, and machine repeats its cycle after each wand is cut.

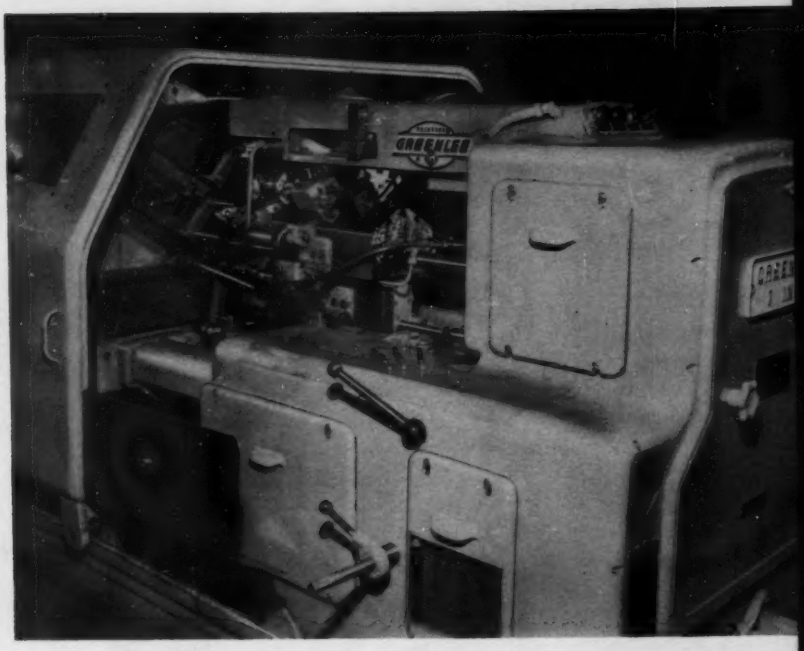


Fig. 8. Armature shafts are produced in four and one-half seconds on this six-spindle bar machine. Seven diameters and four undercuts are formed.

the adapters, swings around, and transfers them to the boring machine without leaving his station. That machine faces, bores, and back-faces the work-pieces, handling two at a time with air clamping integrated in an automatic cycle.

A Brown & Sharpe automatic screw machine, Fig. 6, fitted with a feed hopper and a discharge chute, is teamed with a small drill and an air hammer to perform one of the most interesting processing sequences in the Electrolux plant. The work-piece involved is a small air valve for the vacuum cleaner's spraying attachment. The valve is a two-part assembly—a stem and a knurled bonnet, or cap. The stem originates as brass tubing; the bonnet is a plated die casting with a centrally cored hole to accommodate the stem.

The screw machine illustrated produces the stem and also assembles the two parts. Stock for the stem is turned and knurled. To one side of the machine is a hopper which feeds bonnets into a chute on the front slide. Each bonnet, in turn, is advanced to the center line of the machine spindle and pressed over the knurled diameter of the stem just made. Next, the assembly is cut off to proper length, ejected, and slides down the chute seen extending from the end of the machine.

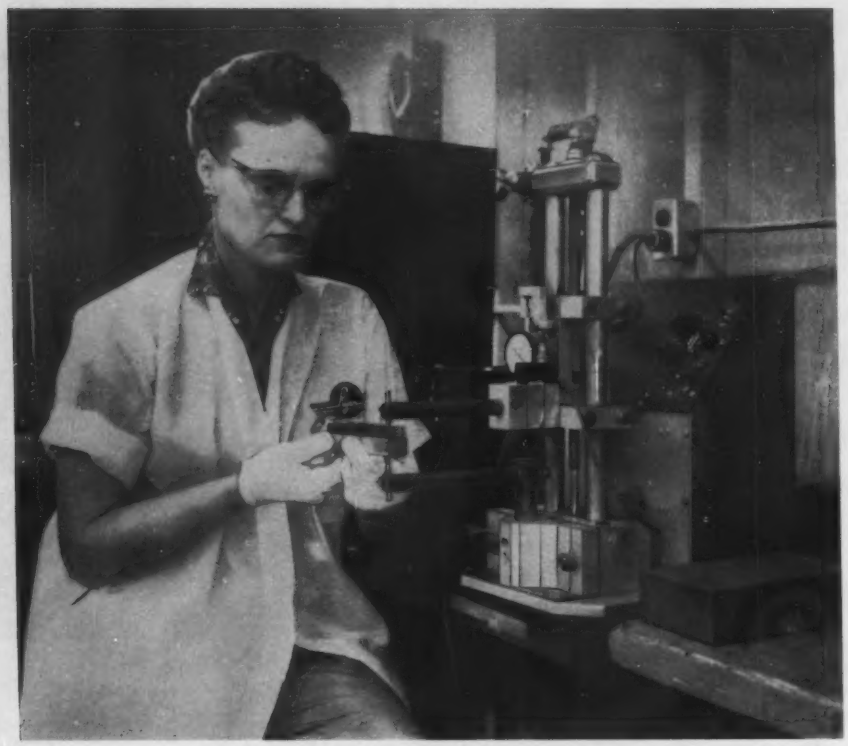
Discharged from the chute, the assembly enters the fixture of the drill. Here it is clamped, and apertures are cross-drilled in the stem. At the same time, the air hammer scribes a witness mark on the bonnet to indicate the angular position of the apertures. Once the drill retracts, the assembly is released and drops into a tote box. No manual labor is required in the processing, either at the screw machine or at the drill, except for the occasional loading of the stems and the bonnet stock.

Wands Sheared in One-Second Cycles

Aluminum tubing is cut to required lengths at a phenomenal speed and without waste on the Brehm equipment, seen in Fig. 7. The tubes are for the wands which connect the hose to the vacuum cleaner's tools and attachments.

Stock is loaded onto an arbor and a carriage moves it forward into contact with a stop. A shimmy die shears off a length, the carriage moves the stock forward, and the cycle is repeated. The entire cycle lasts but one second, increasing production 300 to 400 per cent over a previous cutting-off method. This same machine is also used to cut off several short brass tubes at high speed, with no loss of material and practically no burr.

One of the newest pieces of equipment in the plant is the Greenlee six-spindle, 1-inch bar automatic appearing in Fig. 8. In just four and one-half seconds this machine completely processes the armature shaft for the vacuum cleaner motor. Shaft material is 1137 steel. Seven diameters and four undercuts are formed. As the shafts are ejected, they are automatically conveyed to a centering machine which drills centers in both ends.



CHARLES O. HERB
Editor

Welding Ultra-Thin and Thick Materials Together

Stainless-steel strip as thin as 0.001 inch welded to 3/4-inch thick block

WELDING EXPERTS at the Ryan Aeronautical Co., San Diego, Calif., are noted for their ingenuity in applying welding processes to meet the unique problems of aircraft and missile manufacture. Recently, these experts achieved another "impossibility" by successfully completing a project to develop a method of resistance welding sheet metal a few thousandths of an inch thick to plates of substantial thickness. Specifically, the aim was to provide for welding plates together whose thickness ratio exceeded 4 to 1.

What has been accomplished is typified by the object held in the hands of the operator in the heading illustration and in Fig. 1. The object consists of a 3/4-inch-thick block of stainless steel to which ten leg-shaped strips of stainless steel have been successfully welded. These strips range progressively from 0.001 to 0.010 inch in thickness, reading from left to right.

The Ryan welding engineers point out that when using normal methods of resistance welding, the weld nugget usually forms within the thick material instead of equally at the interface of the two metals. This causes a weak, unsatisfactory bond. The method which they have developed produces a uniformly accurate and securely bonded structure. At the same time it is simple, safe, and convenient to use. Ryan's process involves three main factors: the application of a welding electrode under a heavy-unit pressure at the spot to be welded; shooting a heavy pulse of current to the electrode; continuing electrode-contact pressure until the weld nugget is sufficiently cooled.

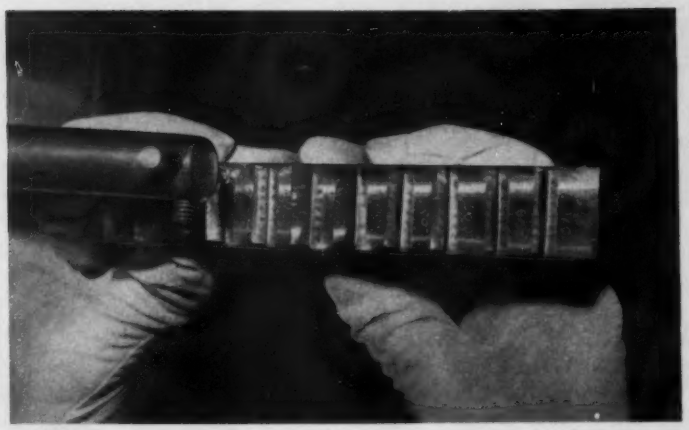


Fig. 1. Welding ten pieces of stainless-steel strip ranging from only 0.001 to 0.010 inch in thickness to a stainless steel bar 3/4 inch thick.

The welding apparatus is comparatively simple. It consists essentially of a power supply, timing mechanism, and a pressure system. The power source comes from connecting opposite ends of the primary winding of a transformer. A timer is connected to the power source and is arranged to discharge through the primary winding of the welding transformer. A secondary winding of the transformer is connected at one end to the welding electrodes. The other end is either grounded to the welding table or attached to the thicker of the two materials being joined.

A wheel type electrode is ideally suited for use in the new welding process. The electrode must exert constant pressure on the work surface to hold the materials securely together at the point of weld. The wheel should then roll along the surface of the thin material to produce a row of spaced spot welds. Other types of pressure-contact electrodes may be used, provided the pressure can be accurately controlled.

The timer employed must be able to precisely control both the power and pressure. Timing will vary according to the material used and the type of welding being performed. When the current is released through the primary winding, a pulse of welding current flows through the secondary winding. The transformer then delivers a heavy-current flow at low voltage through the welding electrode on the work surface. A current of about 40,000 amperes at two volts has been satisfactorily used.

The electrode contact pressure also controls the interface resistance of the materials to a considerable extent, because the firmer the contact, the lower the resistance. Therefore, control of the electrode pressure must be precise. A critical factor is the surface resistance at the contacting faces of the metals. The electrode pressure is set in relation to the other factors that control the interface resistance. Thus the interface resistance represents practically the entire resistance to the welding current. Because the surface finish of thin sheet metal is generally smooth, the interface resistance can be made nearly constant.

When the welding current is applied, the great-

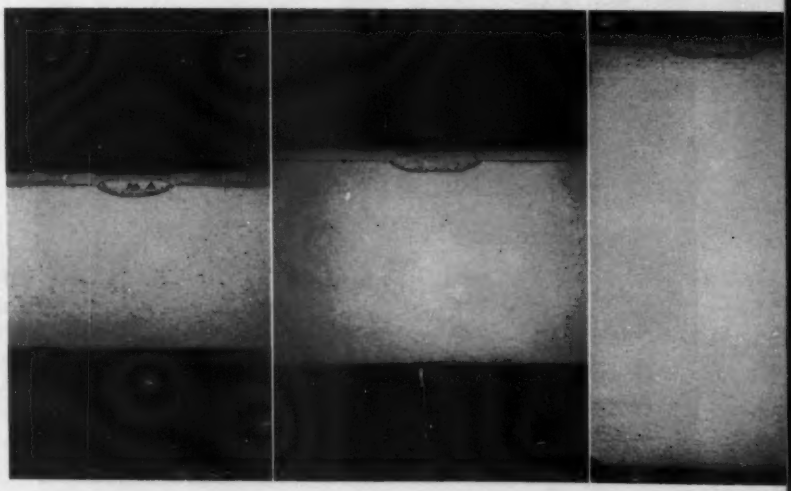


Fig. 2. Photomicrographs showing what happens when stainless-steel strips 0.004 inch thick are spot-welded to bars of three different thicknesses.

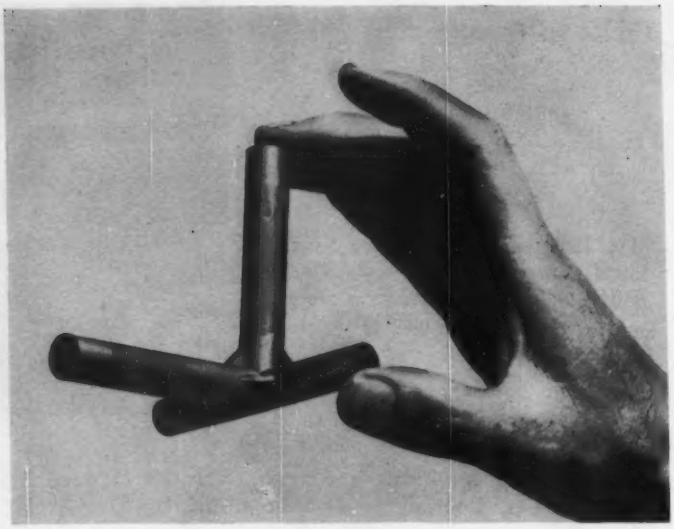


Fig. 3. Three-legged weldment of titanium-alloy tubes that are only 0.00025 inch in wall thickness.

est heat build-up is at the interface of the metals which is the area of greatest resistance. For this reason, the weld nugget forms equally at the contacting faces of the material. Rapid quenching encountered in welding foil gages results in the requirement of accurately controlled follow-up of the pressure system to prevent cracking and expulsion.

Because the total quantity of heat involved is small and concentrated, radiation and conduction losses are minor. The weld nugget solidifies almost immediately, yet not before the electrode pressure is removed, or before satisfactory forging action is completed. Also, with the extremely thin materials used, the size of each weld nugget is small, and the surface distortion of metals from follow-up pressure is negligible.

Using a wheel type electrode, advancing as much as 15 inches per minute and making ten welds per inch, it has been found that the electrode pressure is maintained long enough to avoid cavitation. When welding requires a longer time period, excess heat is generated, requiring a longer time for cooling and making it impractical to maintain a complete follow-up pressure with fast, repetitive welding.

Three photomicrographs in Fig. 2 show that with this welding method there is no distortion of the top surface of the thin strip. The left-hand views shows a 0.004-inch-thick strip of 321 stainless steel welded to a sheet 0.050 inch thick. In the center is a 0.004-inch strip welded to a sheet 0.064 inch thick. At the right is a 0.004-inch-thick strip welded to a sheet 0.125 inch thick.

The unique achievements that can be accomplished today are typified by the weldment illustrated in Fig. 3. Titanium tubes only 0.0005 and 0.00025 inch thick have been joined by spot welding.

Another example of welding performed by Ryan engineers is shown in the photomicrograph reproduced in Fig. 4. It shows what happened when ten sheets of B 120 UCA titanium were joined by resistance welding.

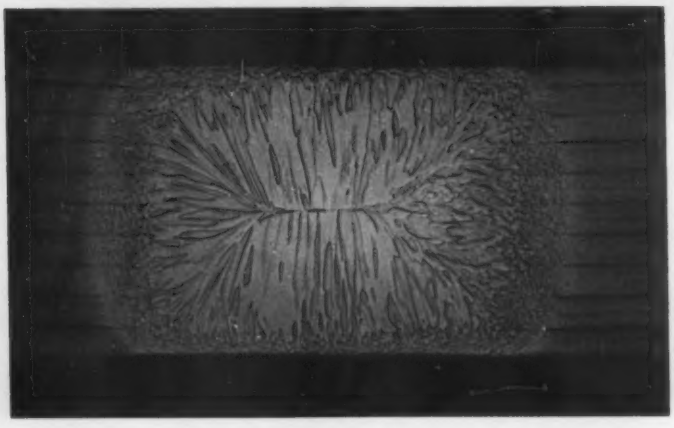


Fig. 4. Photomicrograph of ten thin sheets of titanium alloy that have been successfully welded together.

SIMPLE PROCEDURES ESTABLISH REALISTIC TOLERANCES

Part II: Tolerances for Fits and Clearances

N. L. ENRICK

IN THE FIRST INSTALLMENT of this series, simple additive combinations of tolerances were examined. It is apparent, however, that the statistical tolerancing formulas developed apply with equal validity to problems of fits and clearances.

Example 1. Fit Tolerance Resulting from Assembly of Hole and Shaft

	Hole	Shaft	Interference Fit
	(Ten-Thousandths Inch)		
a. Design size*	4510	4521	11
b. Tolerance +	7	0	
−	0	4	
c. Aver. with product centered between limits	4513.5	4519	5.5
d. Tol. from aver. ±	3.5	2	
e. Fit tol. = $\sqrt{3.5^2 + 2^2}$			±4.0
f. Expected fit 5.5 ± 4.0			1.5 to 9.5

*The design size of a part is that size from which the limits of size are derived by the application of tolerances. If there is no allowance for fit (clearance or interference), then the design size is the same as the basic size.

Tolerances for Fits

An interference fit between the hole in a gear hub and a shaft involved the dimensions and tolerances shown in Lines a and b of Example 1. The succeeding lines show the determination of the expected tolerance for the fit, using the now-familiar formula shown in line e.

Note that the value of 0.0011 inch in the third column represents the fit which occurs when the interfering extremes happen to meet; in particular, a minimum bore diameter assembled with a maximum-diameter shaft. However, this is a most unlikely mating under random assembly in mass production. The probable fit for the vast majority of assemblies is defined by the average difference of 5.5 plus and minus the fit tolerance of 4.0, thus giving a range of 1.5 to 9.5 for the expected fit under random assembly.

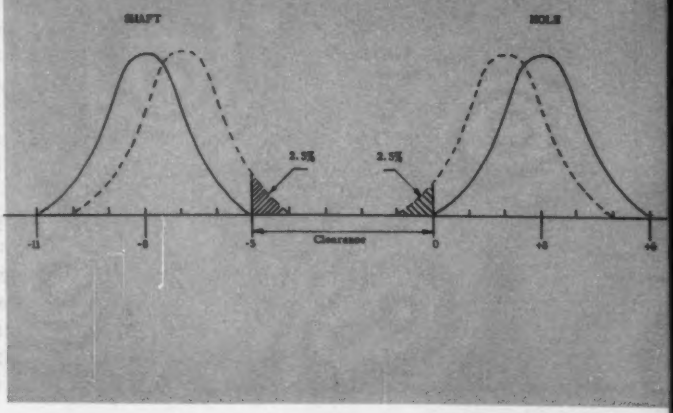
In practical manufacture, the tolerances for the two parts can thus be opened up, and an effective fit of 0 to 11 would still be maintained. However, as stated in Part I, conditions of statistical control and random assembly must be satisfied. Furthermore, it is important to note that the fit tolerance was computed with regard to individual parts centered at least approximately in the middle of the specification limits. *In actual production, this means that the shop must "shoot for the middle" of the part dimensions.* The need for such practice becomes apparent whenever the processing equipment used is barely better than required to meet specified limits.

In those instances where the process variability is relatively small, so that the natural tolerance is markedly narrower than the specified limits, it is no longer desirable to aim production toward the center of the limits. An appropriate shift toward the desirable direction will then usually yield better fits and improved quality.

Tolerances for Clearances

We have just seen how the general formula for a combination of tolerances will hold not only for

Fig. 1. Distribution of diameters of a hole and a shaft.



accumulative assemblies but also for interference fits. We will now see how realistic tolerances can be obtained, using the tolerance formula in clearance fit problems, as illustrated in Example 2. The data are in terms of 0.0001 inch; and the expected minimum clearance of 7 is larger by 2 than the allowable minimum clearance of 5. This suggests that if the mean diameter of the hole were to decrease by 1, with an increase of 1 for the shaft, thus using up the approximate difference of 2 between nominal and expected minimum clearance, no assembly failures should result.

Effect Obtained by Shifting Dimensional Averages

The effect of such a shift in dimensional averages is illustrated by the dotted frequency distribution in Fig. 1, which would seem to indicate at first glance that off-standard product does occur, since 2.5 per cent of the holes and 2.5 per cent of the shafts infringe on the minimum clearance specified. This first impression is erroneous, however, since in actual assembly most of the oversize shafts (between −4 and −5) will usually meet with holes of +1 and wider, thus preserving the minimum clearance of 5. A similar effect may also be expected for the undersize holes. A small percentage of less than allowable clearances will of course occur, and this may be determined as shown next.

Example 2. Clearance Tolerance Resulting from Assembly of Hole and Shaft

	Hole	Shaft	Clearance Fit
	(Ten-Thousandths Inch)		
a. Design size	8000	7995	5
b. Tolerance +	6	0	
−	0	6	
c. Aver. with product centered between limits	8003	7992	11
d. Tol. from aver. ±	3	3	
e. Clearance tol. $= \sqrt{3^2 + 3^2}$			±4.0*
f. Expected clearance = 11 ± 4.0			7.0 to 15.0

*Rounded out. Since the individual tolerances are alike, we could have used more simply $\pm 3 \times \sqrt{2}$.

Nomograph of Expected Assembly Failures

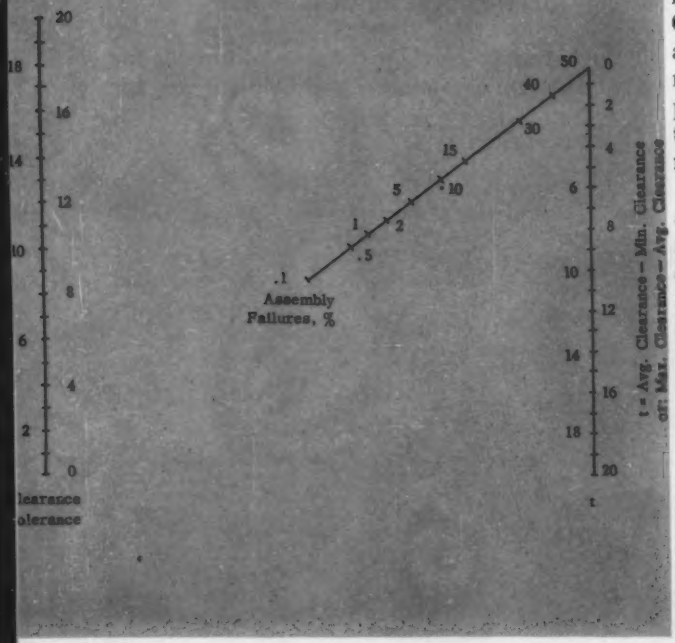
Expected assembly failures may be determined directly by means of the convenient nomograph in Fig. 2, due to Dr. J. N. Berrettoni (first published in Automotive Supplement No. 1 by the American Society for Quality Control). Thus, for our example of a maximum allowable clearance of 15 and an average clearance of 11, we enter the nomograph on the *t*-scale for $t = 15 - 11 = 4$. Connecting this 4 with the value 4 on the clearance tolerance scale, we cross the diagonal line, representing expected assembly failures, at 0.3 per cent. Thus we would expect 0.3 per cent of the assemblies to have clearances in excess of the maximum allowed by the tolerance.

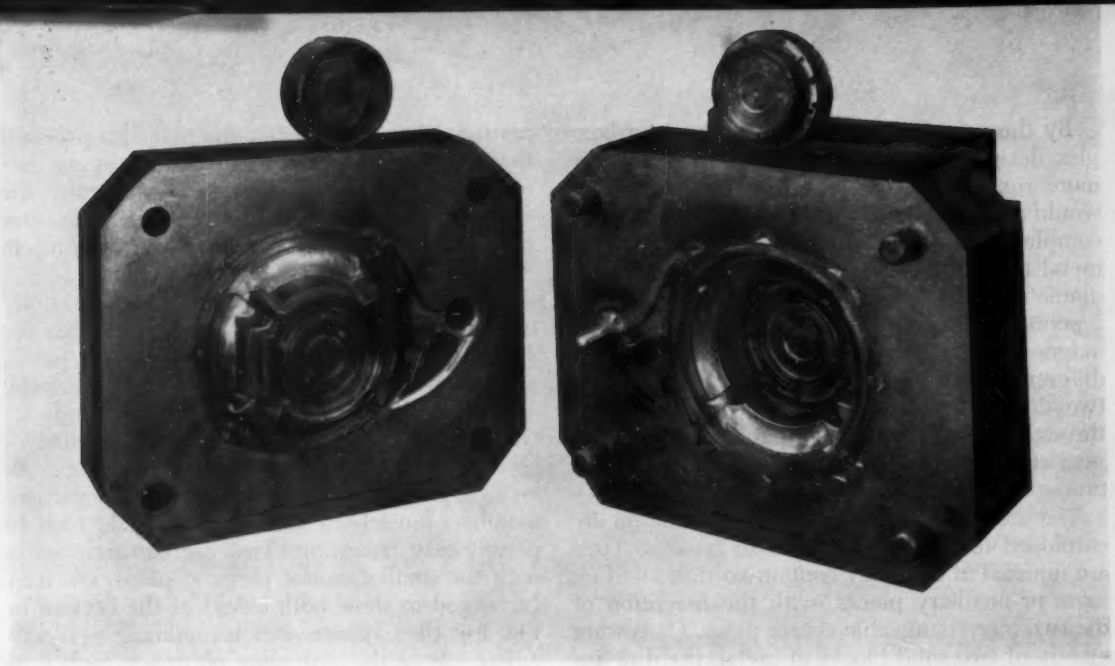
As a further illustration, for a minimum clearance of 9, an average clearance of 11 (with a resultant *t* of 2), and again with a clearance tolerance of 4, we would find 8 per cent of the assemblies with clearances narrower than allowed by the specified minimum of 9. It is obvious that where the minimum clearance is 0, the nomograph will yield the expected per cent of interferences.

The nomograph is thus useful in showing expected percentages which will exceed the maximum allowable clearance or fall below the minimum, as well as the expected interferences in assembly.

A third, concluding installment will take up combinations of accumulative and clearance tolerances.

Fig. 2. Nomograph for determining expected assembly failures.





Well-Designed, Economical Die Casting Improves Loudspeaker Performance

HAROLD W. BREDIN
Associate Editor

Modern high-fidelity loudspeakers need rigid frames with good damping characteristics. A leading manufacturer of high-quality loudspeakers has improved the speaker performance by the use of a zinc-alloy die casting with complex, thin-wall sections. Good die design resulted in low-cost production of the part which won a die-casting design award

WHEN A PRODUCT is improved both functionally and in appearance and yet manufactured at lower cost, it is almost always due to judicious designing rather than fortunate coincidence. Excellent examples of parts greatly improved by diligent redesign and produced at substantial savings are the frames, or baskets, for high-fidelity loudspeakers seen in Fig. 1. These speaker baskets were redesigned as thin-wall zinc die castings by University Loudspeakers, Inc., White Plains, N. Y. The Mount Vernon Die Casting Corporation, Stamford, Conn., skillfully designed the die and produced the parts. So successfully were the purposes of the redesign accomplished that the designer of the basket, Bernard Sharp, was awarded first prize in the recent "Lighter Than You Think" die-casting design contest sponsored by the New Jersey Zinc Co.

High-performance, high-fidelity loudspeakers, such as the 12-inch, two- and three-way speakers (Fig. 2) in which these die castings are employed, require frames, or baskets, having good acoustical damping properties that would extend and improve speaker response. Thin ribs should be used to reduce sound reflections, yet the baskets must be structurally rigid. To achieve these ends, Zamak 3, a zinc die-casting alloy, was employed. This alloy not only has good damping properties but can be used to produce die castings with complex shapes and extremely thin wall sections. The minimum wall thickness of the die-cast speaker baskets is 0.040 inch.

By the use of curved arch sections in a complex design, the thin walls result in a stronger, more rigid frame in proportion to weight than would a basket made with heavier walls and less complex sections. This minimized the amount of metal used in the casting, which is 13 inches in diameter and 4 5/8 inches deep, yet weighs only 2 pounds 12 ounces. The zinc alloy also prevents magnetic losses through the speaker frame. Seven different speaker models are being made from two different baskets produced in a single die through the use of the two interchangeable plugs seen at the top of the dies in the heading illustration.

The dies shown in the heading illustration are employed to produce the speaker baskets. They are unusual in that they contain no slides and no loose or auxiliary pieces, with the exception of the two interchangeable center plugs. Consisting mainly of two solid blocks of metal, the dies are made so that the parting line does not coincide with the edges of holes or other sections. Actually, the parting line and flash occur within holes and thus the top or bottom edges of holes are formed by the solid die. In this way, these edges are not left sharp when flash is trimmed from the casting. The solid die construction also prevents build-up of burrs and thereby eliminates any secondary deburring operations. Untrimmed die castings, produced with the larger set of center plugs in place in the die, are shown at the top in Fig. 1.

Hydraulically actuated, plunger type machines of 500-ton capacity are employed to die-cast the speaker baskets at the rate of 90 to 100 pieces per hour. The parts are trimmed inside, outside, and in the holes by a single stroke of a special trimming die. This die also has an interchangeable member in order to permit trimming both types of baskets. Many sections on nearly vertical members have been set out about 1/32 inch to permit easy trimming. Two die castings, made with the smaller center plugs in place, are seen (arranged to show both sides) at the bottom in Fig. 1 as they appear after trimming.

The use of the zinc alloy permits a high production rate and the casting of thin sections which results in each part containing less material than would be possible with other metals. These advantages and the skillful die design account for the over-all economy obtained in die-casting the basket. If the part or the die had not been de-

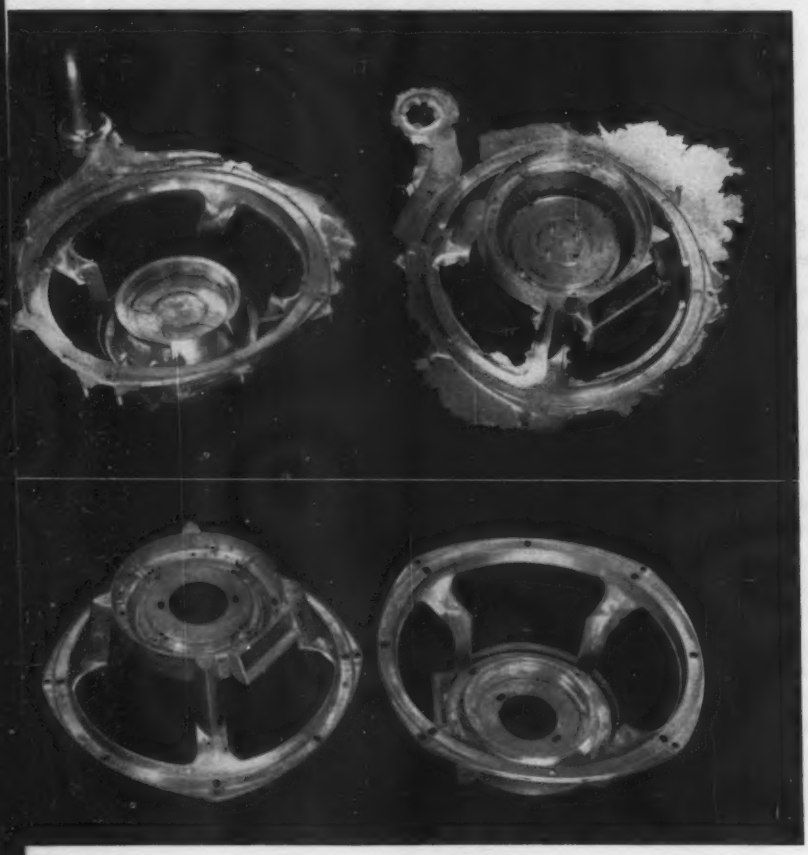


Fig. 1. Die-cast speaker baskets as they appear before (top) and after trimming (bottom). The castings at the bottom were produced with the die set up as seen in the heading illustration, while those at the top were cast with the larger plugs installed in the die.

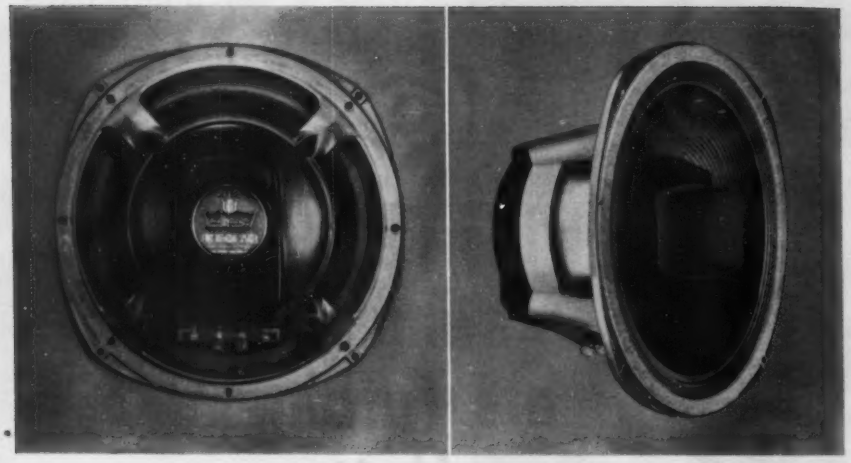


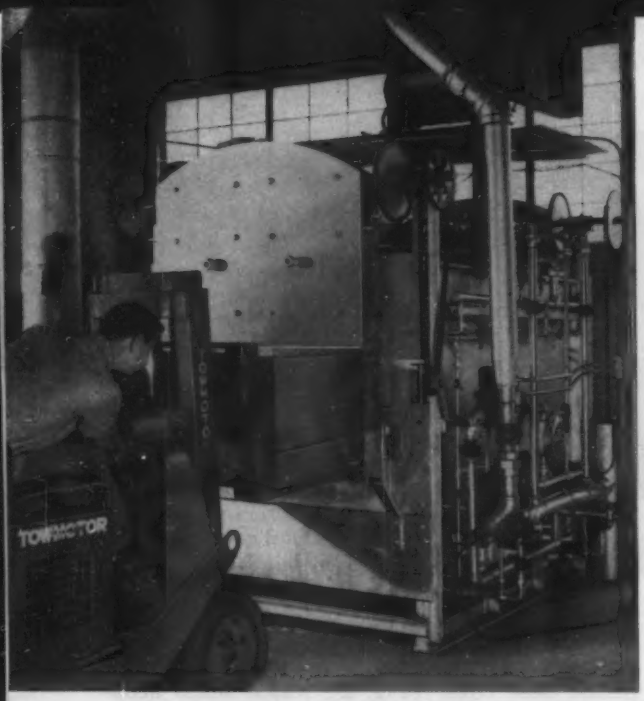
Fig. 2. Side and back views of 12-inch high-fidelity speakers made with zinc-alloy die-cast baskets. Use of accurate-fitting, injection-molded, black plastic dust cover is possible by this design.

signed properly, undercuts would have been necessary, requiring the use of slides in the casting die, and would have reduced the production rate considerably. Trimming would also have been made more complicated and little or no savings might have resulted.

As to the accuracy of the casting, the tolerance on the distance between the diaphragm mounting shoulders and on their concentricity is plus or minus 0.005 inch. In addition, two holes are machined to a plus or minus 0.0005-inch tolerance for the purpose of centering the speaker-coil and magnet assembly in the basket. The die-cast basket also allows the use of an injection-molded plastic dust cover (Fig. 2) which snaps accurately in place and requires no further finishing.

The previous basket design was an assembly of steel stampings with an expensive, spun aluminum dust cover. Another advantage of the die casting is that it is designed for easy stacking during shipment and preliminary assembly operations. A baked metallic enamel finish is applied to the die-cast basket, giving the finished speaker an over-all attractive appearance.

Die-steel springs, acting as spacers, are illustrated here being used by the Boeing Aero-Space Division to minimize distortion of thin-gage aluminum sheets during heat-treating. By restraining the coiled sheets and eliminating metal-to-metal contact, these springs have helped to prevent warpage, weak spots, whiplash damage, and lowered mechanical properties. The space provided by the springs insures uniform heat distribution and quench-water circulation. Made of Type H-11 die steel, the spacers retain their tension through hundreds of heat-treat cycles. Best results are obtained with 8-inch-long springs having an outside diameter of 1 inch and made of 0.063-inch-diameter wire.



Vanes are packed in Chromallizing compound in a closed retort, and inserted in a gas-fired, atmosphere-controlled furnace. After twenty-four hours, they are removed, cleaned of compound, and are ready for welding to engine's inner ring and outer shroud.

Diffusion Coating Lets Turbines Run Hotter

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A POWDERED-METAL protective coating on the vanes in gas turbines is boosting shaft horsepower without major modification of engine design for Avco Corporation's Lycoming Division. "Chromallizing," as the coating process is called, diffuses chromium into the skin of the vanes, forming a new surface alloy which is integral with the base metal.

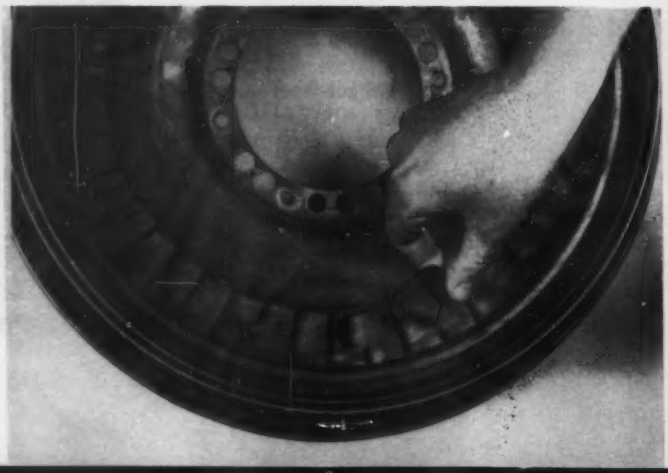
Because of the coating, more fuel and air can be fed into the engine's combustion chamber, since the vanes can operate at a hotter temperature without failing. Even a small increase in operating temperature is important, because it can result in a significant increase in available shaft horsepower. A 3 per cent rise in temperature, for example, can up horsepower 12 per cent.

When turbine inlet temperatures averaged 1600 degrees F., available uncoated superalloys were satisfactory vane materials. At present, however, vanes are required to withstand temperatures in excess of 2000 degrees F., and some form of surface protection is mandatory.

Chromallized vanes are used in two types of the gas turbines developed and produced by Lycoming. The T53, rated to 960 shp (shaft horsepower), was specifically designed for many applications requiring lower-power-range engines. It was the first gas turbine of its class to be used in helicopters. T53's big brother, the T55, rated to 2100 shp, is available in turboprop, helicopter, turbojet, or high-speed front-and-rear-drive versions. Both engines are in quantity production. Present nozzle vane material is a cobalt-base alloy, X-40. A typical vane is about 1 1/2 inches long and 1 1/4 inches across the chord; an average engine contains forty or more vanes.

Vanes are investment-cast and welded to an inner ring and outer shroud. For welding, the skin coating at the tips must be removed. However,

High temperatures play havoc with turbine vanes—the hottest parts of the engine. Oxidation can be quite severe. Compare the burned-up blade in the nozzle assembly with a new one held in the hand.



One test conducted by Lycoming's materials laboratory checks turbine vanes for thermal stability. Oxy-acetylene flames rapidly bring vanes to 2000 degrees F.; an air blast cools them. Blades are checked for hairline cracks, oxidation, and other signs of premature failure.

this does not affect the vanes' life because skirt areas are exposed to lower operating temperatures.

The diffusion coating is applied in the White Plains, N. Y., plant of the Chromalloy Corporation. Vanes are arranged in a retort and packed in a powdered compound. This compound contains three ingredients: proper proportions of the chromium; inert matter, which keeps the metal from sintering, and also permits gas circulation; and a catalyst. The retort is then put into a furnace. Upon completion of the diffusion cycle, the retort is allowed to cool and the parts are removed. A ceramic material seals the retort against air leakage during cooling. The ceramic fuses at processing temperatures, and solidifies early in the cooling cycle.

In the process, the active elements of the powder combine with the base metal to form a new alloy. The metal powder introduced is richest at the surface, decreasing as the depth from the surface increases. Metallographic examination generally reveals two or three distinct layers.

Thickness of the coating can be varied considerably, depending on process conditions. And being completely reproducible, it can be held to any desired limit. However, optimum properties are normally experienced with a coating thickness of 0.001 to 0.003 inch.

In addition, some lesser alloying seems to take place below the skin of the base metal, which is visible upon etching. Although this secondary diffusion zone cannot be detected by the microscope, its presence can be demonstrated in a very practical way. When, for example, the entire visible coating is removed by shot-blasting, and the vane subjected to the same heat and time parameters as an uncoated one, the previously coated vane holds up much better. Electron microprobe analysis indicates that the Chromallizing elements form a useful solid solution which affords some degree of extra protection even when the surface coating is damaged or removed. The coating produces a small but reproducible growth, which can be allowed for in design.

Each vane is tested nondestructively for coating thickness. In addition, vanes are spot-checked for oxidation resistance at 2200 degrees F. for 150 hours. A random 1 per cent sampling is tested for thermal shock; some are analyzed for coating microstructure. As a further control, specimen bars Chromallized along with the vanes undergo stress-rupture tests.

Despite these careful testing procedures, vanes with spalled coatings initially appeared in engine assembly areas. (Spalled vanes, not readily detectable, oxidize fairly rapidly in service.) The condition was traced to improper handling methods, and was corrected by covering the vanes during the manufacturing sequence with a protective plastic film.

In welding the vanes to the inner ring and outer shroud of the engine, the coating sometimes crazes, but this does not impair their usefulness. The fine hairline cracks seem to be self-healing. Furthermore, they occur primarily in the outer zone of the coating, seldom penetrating the diffusion zone.

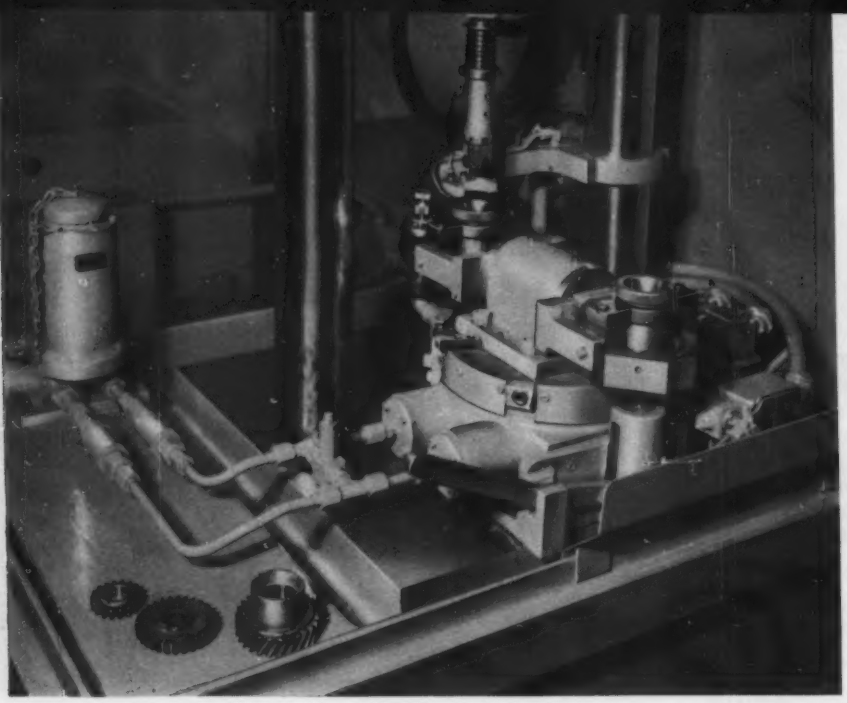


Fig. 1. Rotation of the indexing honing fixture is pneumatically controlled. A hydraulic counterbalance regulates speed of the index and makes action smooth, but it has the advantage of being not a fully hydraulic system.

Gear-Honing Operation in Japan

VERSATILITY, ACCURACY, and SPEED are the outstanding features of a production gear-bore honing machine recently delivered to a Japanese automobile plant by the Barnes Drill Co., Rockford, Ill. Outstanding is a station type work-holding fixture, Fig. 1, which permits honing at one station while the other is unloaded and charged with a work-piece blank. Parts are automotive gears, Fig. 2, with bores about 1/2 inch.

As soon as the hole reaches preset gage size, the fixture indexes 180 degrees to present new work to the tool. Except for loading and unloading, all operations, including gaging, are fully automatic.

Eight different gears are bore-honed on this machine. Fixtures have a controlled, universal floating action. Tooling is of rigid design. Gears with long bores are honed individually at a rate of 116 per hour at 80 per cent efficiency. Short-bore gears can be stacked for two-at-a-time honing that yields 232 parts an hour at 80 per cent efficiency. When two gears are stacked an auxiliary locating plunger can be raised to align the bores.

Barnes "Plugmatic" sizing automatically gages the bore during honing to eliminate errors traced to eccentric or uneven stone wear. Automatic bore sizing on this machine holds consistency within 0.0002 inch from bore to bore. Rotation and reciprocation of the hone head are mechanical. Pneumatic controls regulate hone feed, including automatic, quick hone expansion and collapse within the work-piece bore.

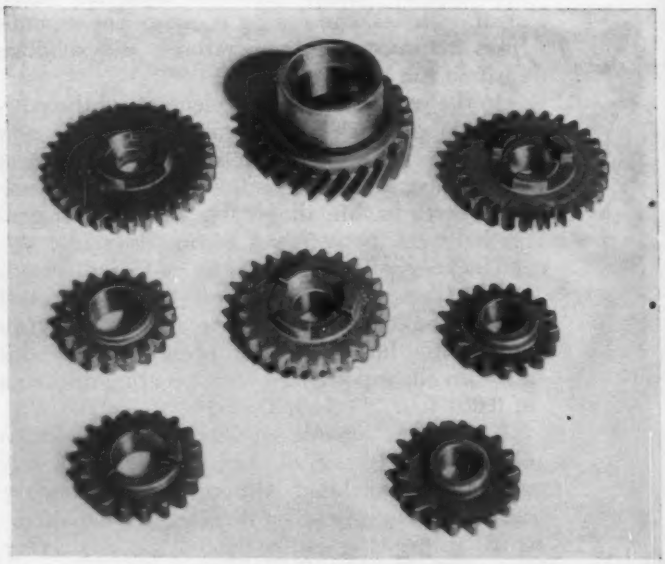
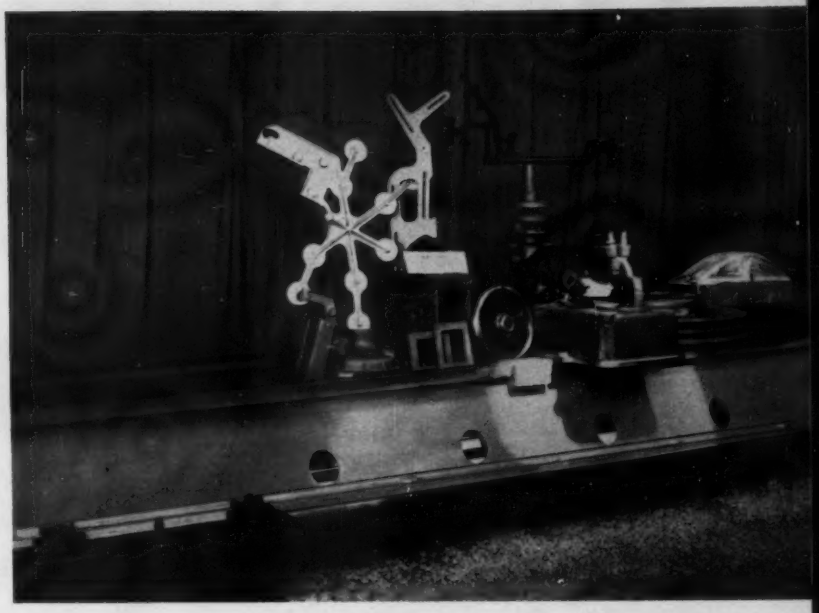


Fig. 2. Automotive gears are SAE 4118 steel. Bores are about 1/2 inch. Stock removed by honing is 0.003 to 0.004 inch. Finish is 15 to 20 micro-inches.



Products of the Textile Machine Works range from minute surgical needles to castings that have a weight of as much as 7200 pounds.

Intensified Manufacturing Diversification Program

Textile Machine Works, Reading, Pa., which gained a reputation as the world's largest manufacturer of full-fashioned hosiery-knitting machinery, recently announced completion of an intensive five-year product diversification program. A week-long open house was held to spotlight the new and varied lines of work. Contract design, engineering, foundry, and machining operations, plus consumer products, now make up a major part of the company's business.

Five years ago the company relied on full-fashioned hosiery machines for about 85 per cent of their sales; now machines of that type account for less than 15 per cent of the total business. The company's progress in general metalworking diversification is indicated by the 30 per cent work force expansion in the past nine months, bringing the total employment to more than 3000 people.

An exhibit of components and operating equipment built for nationally known companies was arranged to display the varied skills of Textile Machine Works to provide contract services to other manufacturers. The exhibit ranged from structural and operating components for such varied products as IBM's 407 accounting machine and New Holland Machine Co.'s Hayliner, a hay baler, to completely operating assemblies such as du Pont's retail paint mixer and dispenser, and an automatic pretzel twisting machine for Bachman Bakeries.

Parts were shown that are made for the electronic, missile, instrumentation, and automatic control fields for such companies as Philco, RCA, Raytheon, and Bendix. Visitors were conducted through a plant erected recently for the finishing of a new line of porcelain-coated cast-iron cookware. This plant is extensively automated.

Visitors Information Book for Machine Tool Exposition

Full information concerning The Machine Tool Exposition—1960, which will be held at the International Amphitheatre in Chicago, September 6 to 16, is given in a booklet you may obtain from the National Machine Tool Builders' Association, 2139 Wisconsin Ave., N. W., Washington 7, D. C. It contains data concerning exhibiting hours, transportation and hotel facilities, registration cards, inquiry timesaver plate application forms, and exhibitors.

In Shops Around the Country

CONNECTICUT—A gas-turbine engine component is pickled ultrasonically at Avco Corporation's Lycoming Division, Stratford. Double-boiler arrangement permits inner tank, containing hot phosphoric acid, to be operated at any desired temperature. Sonogen generator (left) drives eight transducers which convert electrical impulses into mechanical vibrations. Resultant cavitation in pickling tank removes scale, oxides, plating stains, flux, and other contaminants in a few minutes, assuring trouble-free operation of engine.

MICHIGAN—Bearing balls leaving a tempering furnace at Hoover Ball & Bearing Co., Ann Arbor, roll into compartments of "Lazy Susans." At regular intervals, sample balls are inspected for hardness, grain structure, and crush strength. If samples pass inspection, a trap door in the bottom of the compartment is opened into a tote bin. If samples are rejected, only balls remaining in compartment need be scrapped.

WISCONSIN—At Evinrude Motors, Milwaukee, an electrolytically assisted wheel removes 0.025 inch of material per pass in grinding a chip-breaker into a tungsten-carbide tool. The wheel, made of brass, has 120-grit natural diamonds bonded in its periphery. Previously, with "unassisted" conventional diamond wheels it was possible to remove only 0.001 inch per pass.

OREGON—A gigantic 225-ton, 375-foot main-span girder for the new Nisqually Glacier Bridge at Mount Rainier National Park is submerged-arc welded at West Coast Steel Works, Portland. A carriage with a Lincoln squirt welding gun and an acetylene torch travels along the inclined web of the girder. The torch operates during the first of two passes in laying down a 1/2-inch fillet joining the web and the flange, assuring soundness of the weld.

KANSAS—A National Cylinder Gas multiple-torch flame cutter at Parkersburg Rig & Reel Co., Coffeyville, simultaneously processes four parts for its oil-field pumping equipment. The torches, controlled by an electronic scanner which follows a pencil drawing, cut the parts to a tolerance of 1/32 inch. After each cycle, operator moves torches to next starting point in the steel plate.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Cam-Turning Attachment

JOSE C. SOBKOWIAK, Jackson, Mich.

The production of cams in quantity can be a time-consuming and expensive operation, requiring much careful machining by skilled mechanics. With the aid of the attachment here illustrated, however, cams may be readily made in a lathe from a prepared master. After the initial setup, the machining operations required to mass-produce the cams are routine.

Two equal-size sprockets, *A* and *B*, are mounted as shown in Figs. 1 and 2—part *A*, on a true machined surface of the chuck and part *B*, on a shaft *C*. This shaft is supported in a bearing *D* secured by screws to a hanger *E* that is clamped to the bed of the lathe. Motion is transmitted by a roller type chain. Universal joints *F* and a telescoping, intermediate coupling shaft *G* serve to drive shaft *H* while permitting both longitudinal movement of the carriage and lateral movement of the cross-slide. This arrangement allows shaft *H* to always rotate at a speed equal to that of the lathe spindle and in the same direction.

Shaft *H* is supported by a bearing *J* in a hanger *K* fastened to a special slide *L*. A collar *M* is keyed to the shaft *H*, and master cam *N* is attached to this collar with screws (Figs. 3 and 4). Slide *L* is fastened to the cross-slide in place of the compound. The screws that normally hold

Fig. 1. Setup for turning cams on a lathe. Tool is guided by a master having the desired contour.

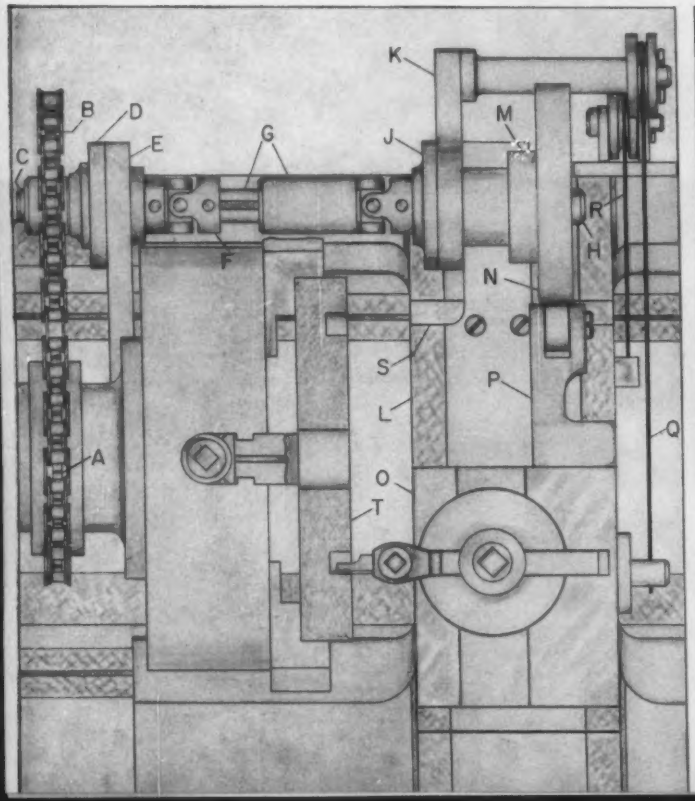
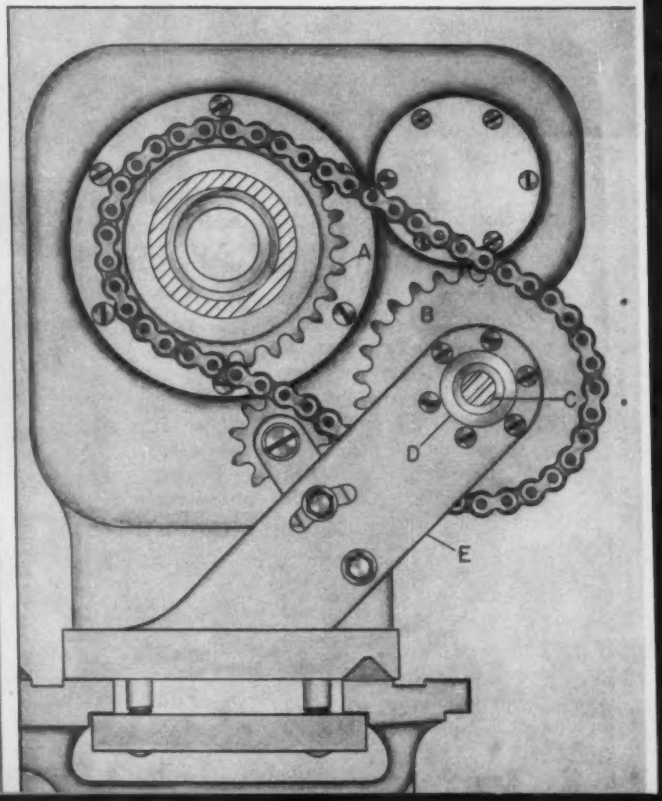


Fig. 2. Roller chain and sprocket drive rotates the master cam at a 1 to 1 ratio with the lathe spindle.



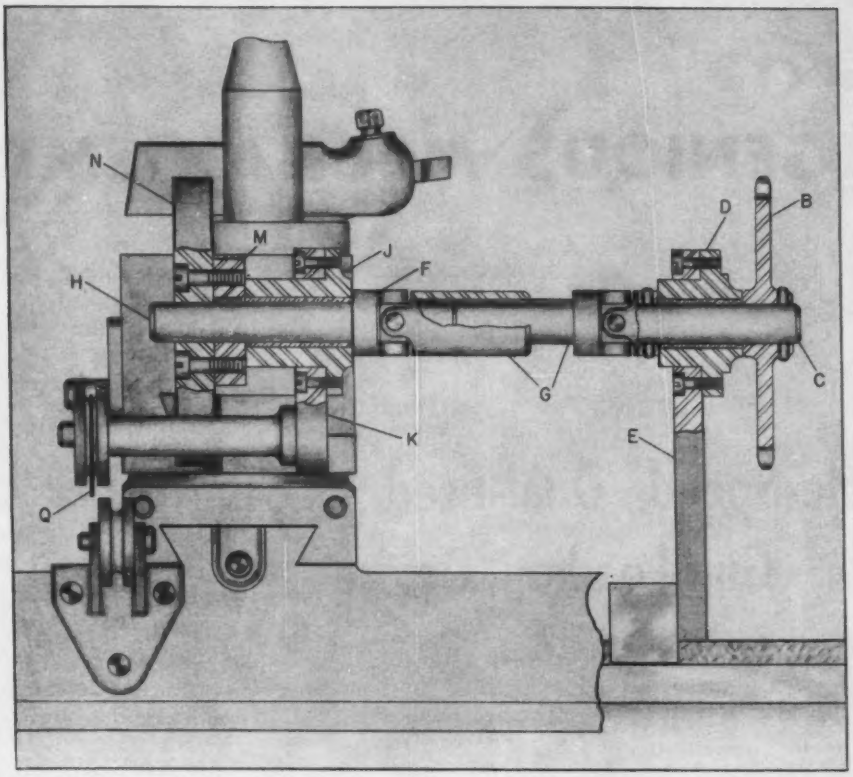


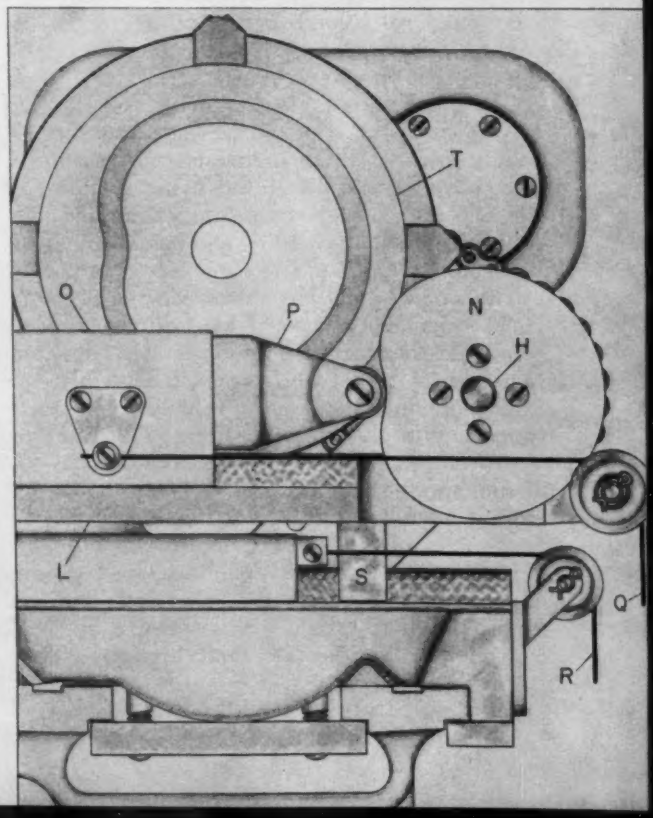
Fig. 3. (Left) Cam-turning device as seen from rear of lathe. For clarity, portions of the lathe have been eliminated.

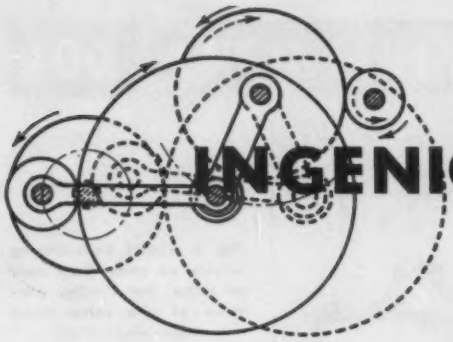
Fig. 4. (Below) A weight is attached to cable (Q) to keep the roller follower constantly in contact with the master cam (N).

the compound are used for this purpose. Toolblock *O* is machined to fit slide *L* and has a *T*-slot for the toolpost identical in size to that in the compound. However, this slot is made parallel to the cross-slide for easier positioning of the tool. When slide *L* and block *O* are fitted together and mounted on the cross-slide, the top of block *O* is at the same height as the top of the assembled compound.

Roller-follower assembly *P* is attached to the block *O*, as shown. A weight secured to the end of cable *Q* is used to keep a constant and even contact between the roller and the master cam. A second weight attached to the cross-slide by cable *R* takes up any play between the cross-slide screw and nut. A block *S* which is machined to fit the dovetail slide of the saddle is fastened to and supports the overhanging end of slide *L*, as illustrated in Fig. 4.

Since the two sprockets are of equal diameter and pitch and are coupled by a roller chain, one turn of the lathe spindle will result in one turn of the master cam. When this cam is rotated, a tool mounted on block *O* may be used to reproduce the shape of the master in the work-piece *T*. Although the cross-slide and the carriage can be moved in the usual manner, the travel of the carriage is limited to the telescoping length of the shaft and sleeve. In addition to cams, this attachment may be used to copy other parts having irregular shapes. Of course, there are limits to the contours that can be reproduced in this way.





INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Variable-Speed, Dual-Feed, Six-Barrel Gun-Loading Device

EDWARD B. SMITH, JR.
Burlington, Vt.

Third Prize Winner in MACHINERY's recent Competition

Men still fly certain of the advanced aircraft such as the Lockheed F-104 and Republic F-105, designed for defense against other aircraft. The speeds of airplanes have increased so greatly that the pilot of a defensive aircraft in combat may have only two seconds or less on his target, because the high relative speeds of the two opposing craft cut time so drastically.

The problem of a gun designer is, therefore, to fire bullets faster, while at the same time keeping weight and space requirements to a minimum. Armament should affect the flying qualities of the airplane as little as possible, offer rapid mission change-over versatility, and possess the quality of high reliability.

The writer's plant has borrowed from the principles originally advanced by Gatling, and has combined them with a unique linkless ammunition feed system that features a closed-circuit drum ammunition-storage mechanism and electromechanical loading and firing. The result is a proven six-barrel gun that will fire 20- or 30-mm ammunition at a rate of 6000 rounds per minute. Such a system is found highly developed in the 20-mm M61 Vulcan aircraft cannon.

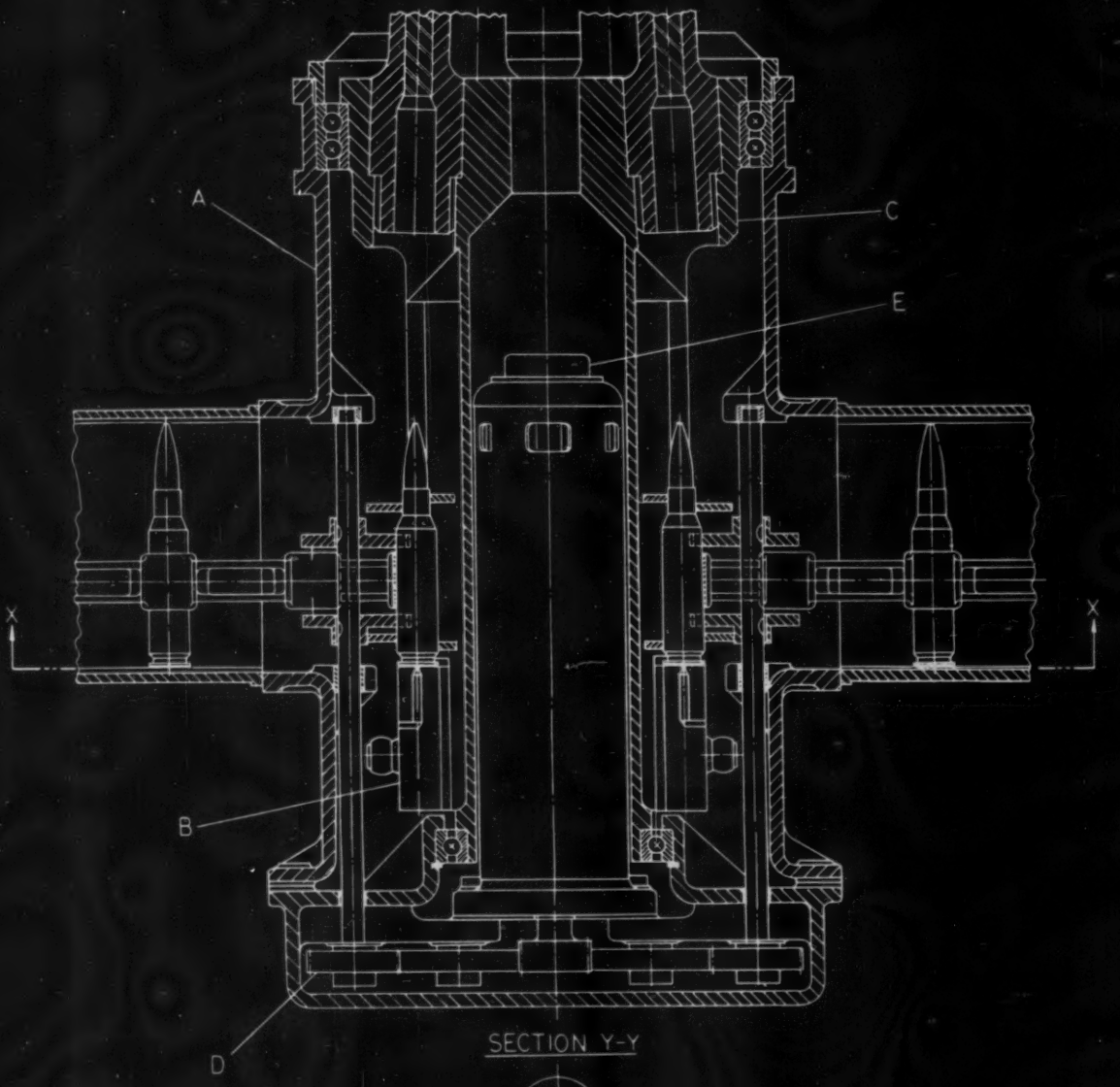
In the new linkless ammunition feed system used on these cannons, the brass cartridges go from a spiral storage chute inside a cylindrical container to the gun, are fired, and the empty shells return to the container in a closed-circuit flow like the balls in a ball-worm steering gear on an automobile.

The dual feed designed by the writer loads and fires two rounds at once instead of one round. In the sketch, Fig. 2, conveyors from right and left feed shells to two gun bolts simultaneously. The bolts carry the shells forward to the barrel breeches, fire them, and return them to the return flights of the conveyors with the rotor and barrel cluster turning continuously.

In the dual feed, Fig. 1, the main housing *A* contains an internal, double-acting cylindrical cam, which controls the fore and aft movement of the slide-carrier bolts, as at *B*. The rotor *C* is driven through gear train *D* by drive motor *E*. The rotor also supports the six bolts *B* in their horizontal tracks. The six gun barrels are supported in front of the rotor, in line with the horizontal bolt tracks.

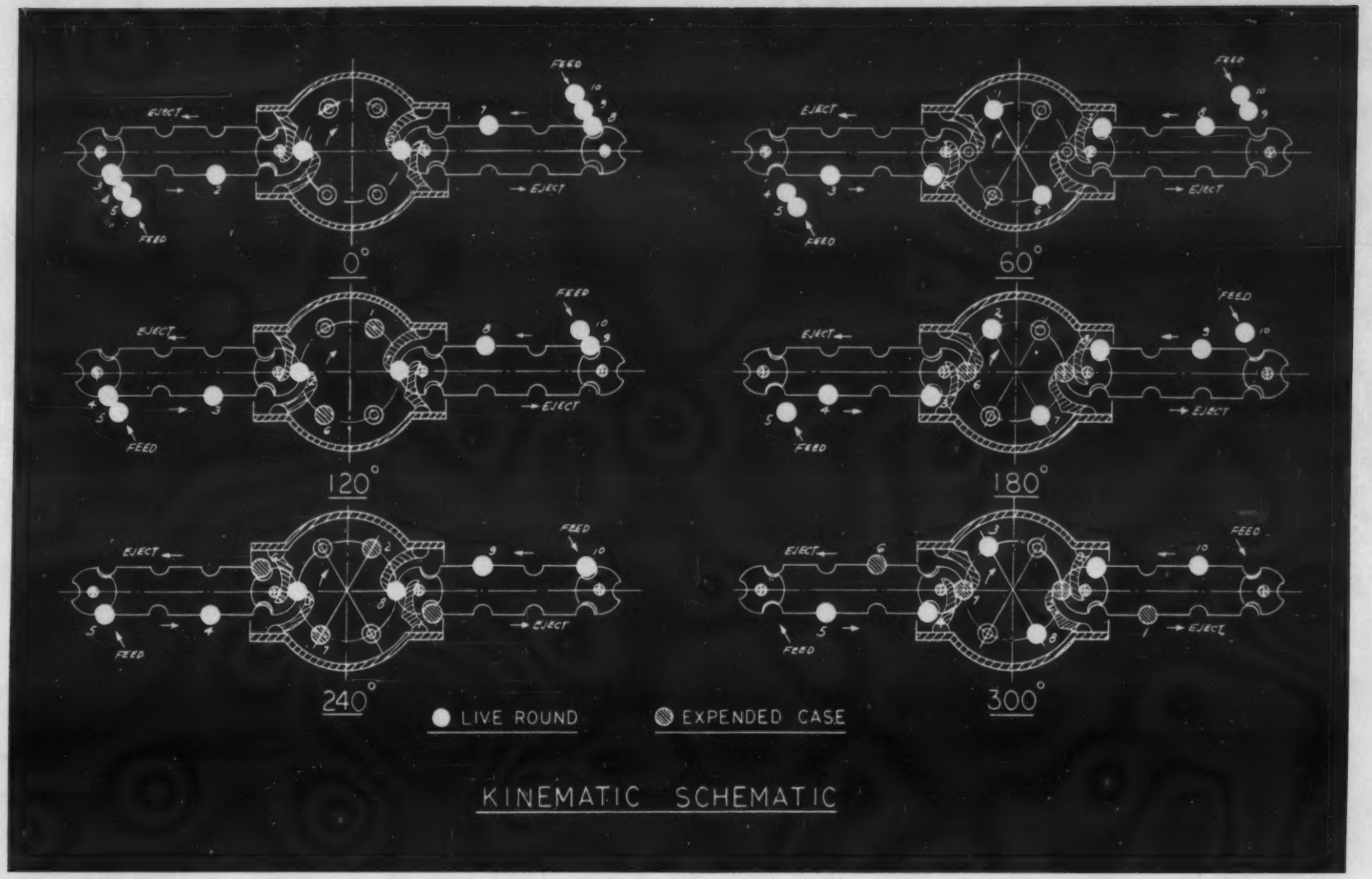
Left- and right-hand feed sprockets *F* and *G* are also driven from gear train *D*. They feed individual rounds of ammunition from alternate spaces of the link conveyor belts *H* and *I* into the bolts. The sprockets also discharge the spent shells into pockets of these conveyor belts. The oscillating, cam-operated pawls *J*, *K*, *L*, and *M* are synchronized through gear train *D*, and alter-

Fig. 1. (Opposite page) Feeding in from both sides, live ammunition is carried forward to the firing chambers by the bolts (B) actuated by their followers riding in a drum cam. Fingers (J), (K), (L), and (M) guide live rounds off the conveyor to the bolts and transfer spent shells back into open conveyor pockets.



SECTION Y-Y

SECTION X-X



KINEMATIC SCHEMATIC

Fig. 2. (Opposite page) Dual loading and firing sequence is shown in this kinematic schematic sketch. The rotor carrying the bolts turns continuously with the barrel cluster during operation. Firing of top and bottom rounds occurs at "12 o'clock," simultaneously with firing of the round from the right at "6 o'clock."

nately provide radial restraint for feeding live rounds of ammunition, as well as removing and returning spent ammunition cases to the belts.

The cycle of action is shown in the kinematic schematic sketch, Fig. 2. The mechanism fires two rounds at once at 90-degree rotation of the rotor from the two loading positions. These firing positions correspond to 12 o'clock and 6 o'clock.

There are many advantages in handling the ammunition in a closed-circuit system. Live ammunition does not slosh. When spent cases and links are dumped overboard from the front of an aircraft fuselage, they can be sucked into the jet intakes or may strike leading edges of wings or stabilizers. Another advantage of the closed-circuit system is that it keeps the weight of the "brass" aboard the aircraft, with the result that less trimming of the ship is needed to compensate for the change in the center of gravity after firing. The guns and storage systems are well adapted to pod type package mounting, in which case spent cases can be dumped overboard. Mounting guns in outboard pods has advantages. The gases from firing are away from the plane's jet intakes, and thus cannot cause "flame-outs."

Applied to an armored tank, this closed-circuit ammunition-storage system has the advantage of keeping the spent shells in the container instead of spilling them on the floor. Older systems dumped spent brass on the floor where it was a hazard to the tank crew when they tried to walk about within the vehicle.

Warner & Swasey Opens New Research Center

Displaying the motto "Building for the Future" on the wall of its main entrance lobby, a newly completed 40,000-square-foot research center of the Warner & Swasey Co. is now in full operation at Solon, Ohio. In addition to machine tool development projects, the center will handle textile machinery and earth-moving equipment design and test work. There are separate departments for machine design, systems design, electronic controls, servo development, instruments and research engineering, as well as metal-cutting and metallurgical laboratories. A prototype shop is capable of fabricating full-scale working models of new product designs.

MATERIALS

The properties and new applications of materials used in the mechanical industries

Die Steel with High Percentages of Carbon and Vanadium

Latrobe Steel Co., Latrobe, Pa., has announced the development of an abrasion-resistant, cold-work die steel for use in brick-mold liners, shot-blast liners, ceramic-tile liners, and for long-run blanking and forming dies.

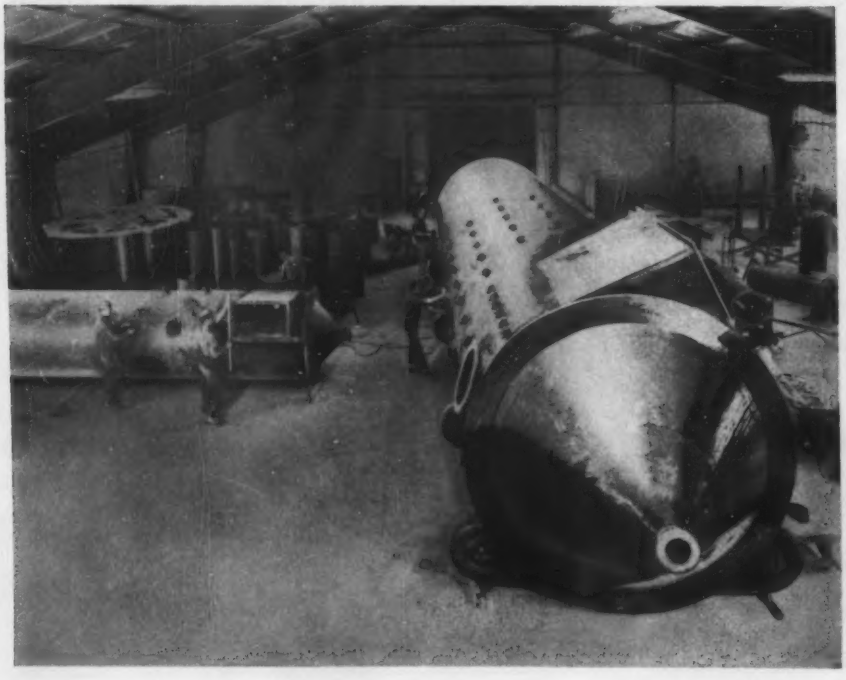
Designated "BR-3" die steel, it contains 2.80 per cent carbon, 5.25 per cent chromium, and 4.50 per cent vanadium. Two of these constituents form hard, abrasion-resisting vanadium carbides for increased wear.

"Do-It-Yourself" Carbides that May Be Machined

Carbide parts and tools that withstand the effects of high temperatures or corrosive media may now be produced right in the shop, according to Sintercast Division, Chromalloy Corporation, 132 Woodworth Ave., Yonkers 2, N. Y. Only conventional tools are needed to machine "Ferro-Tic S," a material available in two grades —"S-45" and "S-55"—that are produced by powder-metallurgy techniques, embedding tiny crystals of extremely hard titanium carbide in a relatively soft matrix of stainless steel.

The resultant composite retains the properties of both of its constituents: the machinability and resistance to heat and corrosion of the stainless steel, and the hardness of the titanium carbide.

The difference between the two grades lies in their relative machinability, one having a hardness of approximately Rockwell C 45, the other, Rockwell C 55. The softer of the two may be machined readily with any single-point or multiple-point cutting tool. The harder one is suitable only for the basic operations, such as sawing, turning,



This giant chemical fume scrubber is said to be the largest unit of industrial equipment ever fabricated from reinforced plastic. It was designed and engineered by Buffalo Forge Air Cleaning Division, Buffalo, N. Y., and is made of a fire- and chemical-resistant reinforced polyester resin, "Hetron 92," a product of Durez Plastics Division, Hooker Chemical Corporation, North Tonawanda, N. Y.

and drilling; milling or tapping are not recommended. Both carbides may be ground and may be joined to other metals by welding or brazing.

Typical applications for these "do-it-yourself" carbides—which are available in blank or round bar form—include valves or valve seats, knives and choppers, seals for pumps, homogenizing valves, nozzles, gages, high-temperature bearings, forming tools, and many other items where cast cobalt-base alloys or tungsten carbides might normally be employed.

Self-Spraying Layout Fluid for High-Precision Work

A smooth, dark, nonglare coating that dries instantly and will not rub off has been announced by Industrial Supply Division, Sprayon Products, Inc., 2075 E. 65th St., Cleveland 3, Ohio. Designated "Sprayon No. 603 Blue Layout Spray," it is particularly well adapted to the fine lines of high-precision work. Also announced was a self-spraying formula specially compounded for quick, clean removal of the layout fluid.

Finely Divided Polyethylene Serves as a Coating Agent

Finely divided, powdered polyethylene has been made available by the U. S. Industrial Chemicals Co., division of National Distillers and Chemical Corporation, 99 Park Ave., New York 16, N. Y. Called "Microthene" polyethylene, it is available in two forms: a low-density, high-melt-index material and an intermediate-density, medium-melt-index material. The material can be applied in powder form or in water or alcohol dispersions or pastes.

Metal parts can be coated using dry powder or dispersions (spraying, dipping, and slush coating). Alcohol dispersions are generally used on metals that would be corroded by water. Applications include coating metal parts for protection against corrosion.

Three Types of Anti-Seize and Lubricating Compounds Announced

A line of anti-seize and lubricating compounds, marketed under the name of "Goop," has been announced by the Crawford Fitting Co., 884 E. 140 St., Cleveland 10, Ohio. The line includes three separate products: "Blue Goop," "Silver Goop," and "High Purity Goop."

Silver Goop was formulated to prevent seizing and galling, regardless of applied load on threaded parts, at temperatures up to 2100 degrees F. It reduces take-up torque on threaded parts. The compound will not drip off red-hot surfaces, nor give off poisonous metal or oxide fumes at high temperatures. It resists water washout.

Blue Goop is an anti-seize and sealing compound for use on titanium, stainless steel, steel, aluminum, and high-temperature alloys. It withstands the effects of heat at temperatures up to 400 degrees F. The material is impervious to water washout, most acids, and all petroleum solvents.

High Purity Goop is an anti-seize and sealing compound for titanium, stainless steel, aluminum, and high-temperature alloys for use at temperatures up to 400 degrees F. It is impervious to moisture and cyclic thermal stress. The compound is recommended for use wherever the prevention of product contamination is desired or essential.

Nonshrinking Casting Filler that Hardens in Minutes

A two-component filler, sealer, and bonding agent developed by Future Chemicals, 3008 W. Montrose Ave., Chicago 18, Ill., that should reduce casting and sheet-metal rejects has been announced. Called "Copy-Cast," it repairs miss-runs, blow holes, and sand cracks; tears, cuts, and dents; burned-plate ridges; and broken castings. The material's adhesive ability and dimensional stability facilitate making permanent repairs which can be sanded, sawed, drilled, tapped, painted, and finished.

Material for Producing Attractive Black Finishes on Zinc Surfaces

A product that is used to produce an attractive durable black finish on zinc, zinc plate, and zinc-base die castings has been announced by the Mitchell-Bradford Chemical Co., Wampus Lane, Milford, Conn. "Black Magic Zinc Black D," as it is called, is used in proportions of 6 to 8 ounces per gallon of water. The parts are treated in a solution heated to temperatures ranging from 150 to 170 degrees F. The solution is nontoxic and the glossy black finish produced may be used as is or as an undercoat or bond for paints, enamels, or lacquers.

Metal Cleaner that Removes Rust-Preventive Oils

A stable, free-flowing, dustless powder that is readily soluble in cool or warm water is now available for the removal of rust-preventive oils (including mill oil) and many other soils from ferrous-metal stock or components, according to the Kelite Corporation, 81 Industrial Road,

Berkeley Heights, N. J. "Kelite Spray Cleaner No. 5-S," as it is called, can be used at room temperature or at moderately elevated temperatures and is especially effective as an alkaline cleaner. It is low-foaming and has good soil-removal properties.

Rub On, Rub/Wash Off Aluminum Polish

A polish that provides a practical solution to problems of aluminum discoloration, pitting, and corrosion has been introduced by the Anton Co., 55 Front St., New York 4, N. Y. The polish, called "Met-All," is said to clean and polish aluminum to a mirror-like finish. It also cleans and provides a protective finish on other metals including copper, brass, silver, gold, pewter, nickel, chromium, and stainless steel. The finish lasts for months and even stands up against salt spray. The polish is harmless to the skin, nontoxic, nonflammable, and easy to apply.

Lightweight Pipe Insulation for Wide Temperature Range Use

"Unarco U-200," a lightweight, rigid, urethane-foam pipe insulation, specially designed for use at temperatures ranging from minus 300 degrees F. to plus 220 degrees F., has been announced by Union Asbestos & Rubber Co., Fibrous Products Division, Bloomington, Ill. It has a K factor of only 0.14 at 70 degrees F., a density of 2.3 pounds per cubic foot, and a high compressive strength.

The material is not affected by most mastics and sealers normally used for cold insulation. It is self-extinguishing, and exhibits no capillarity. The nontoxic, nonirritating product is available in half-round sections 36 inches long, or blocks, and can be cut to size and shape quickly and easily with simple hand tools.

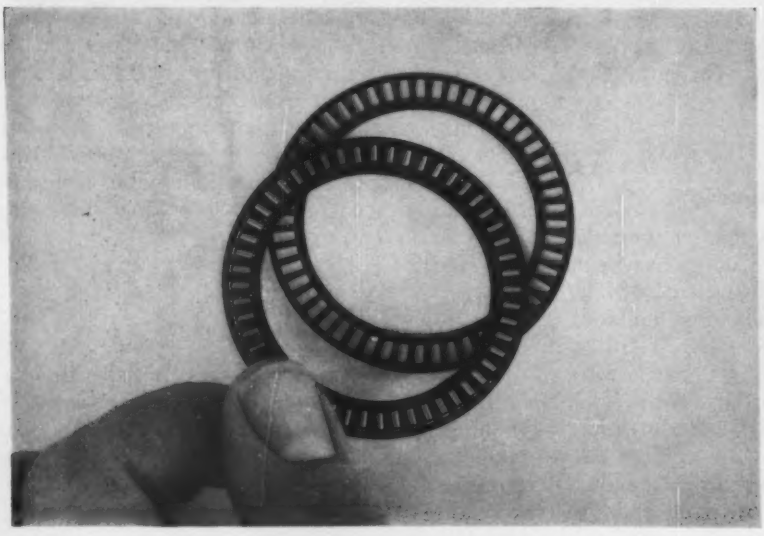
Hard Thin-Film Rust Preventive for Metals

A rust preventive compound that dries to a very thin, hard, clear film, and which protects parts from several months in outdoor exposure to several years in indoor storage, has been placed on the market by the Al-Con Chemical Co., Box 8168, New Orleans 22, La. Called "Alconol 102-A," it is hard and nontacky, and treated surfaces will not pick up dust, grit, and dirt, nor will the film rub off during handling. It dries at room temperature in twenty to thirty minutes, or can be oven-dried in one or two minutes at 200 degrees F.

The compound is applied by brush, spray, dip, or roller, and is safe to handle because the flash point is 105 degrees F. It affords protection to most metals in such applications as tools, machinery, gears, and hardware.

Long-Length Tantalum Tubing Made Available

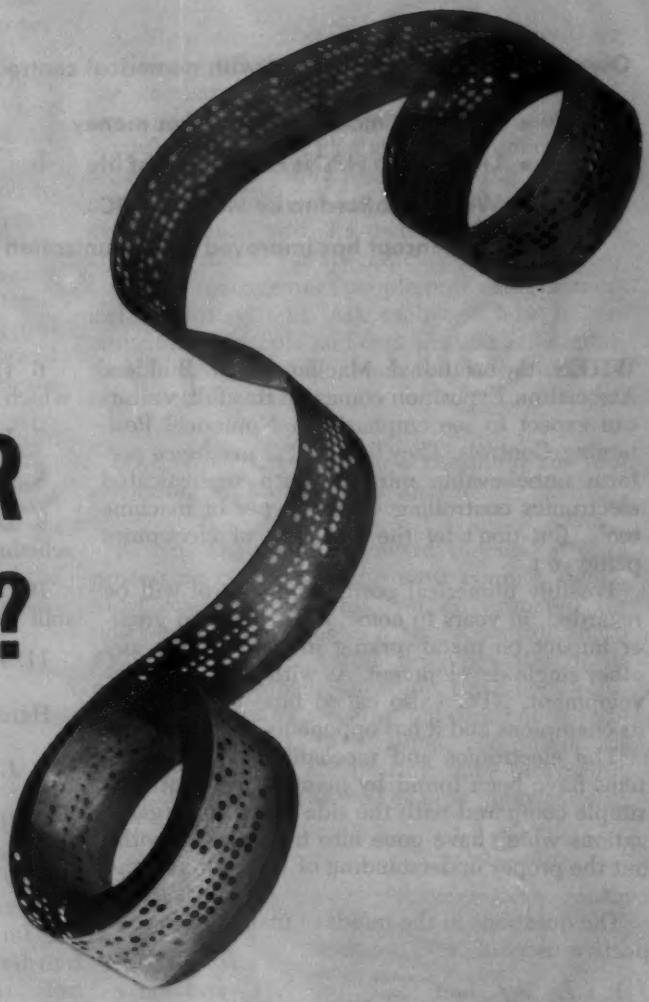
Seamless tantalum tubing in lengths up to 60 feet has been produced by the Wolverine Tube Division, Calumet & Hecla, Inc., 17200 Southfield Road, Allen Park, Mich. The tubing is virtually unaffected by highly corrosive acids of all kinds, and is used in the production of heat exchangers and acid concentration equipment. It is available in sizes ranging from 0.453 inch to 1.500 inches outside diameter and in wall thicknesses ranging from 0.015 to 0.125 inch.



The cage of the roller thrust bearing shown makes use of a glass-filled nylon, and any foreign metal present in the bearing area imbeds itself into the plastic. This imbedment removes ordinarily loose metal particles from circulation, thereby reducing bearing abrasion and consequent wear of adjoining metal surfaces. The molded-in retention cavities firmly position and hold the bearings, which are simply popped into the receptacles. The material has good wear resistance and requires no lubrication, according to the manufacturer, the Garlock Packing Co., 442 Main St., Palmyra, N. Y.

MACHINERY'S *Reference Section*

Numerical Positioning Control— PROFITS OR PROBLEMS?



LAURENCE W. COLLINS, Jr.
Associate Editor

July 1960

NUMERICAL POSITIONING CONTROL—
Profits or Problems?

Owners of machines equipped with numerical controls say . . .

- **NPC on a machine tool makes money**
- **Living with NPC is a new way of life**
- **We can't afford to be without NPC**
- **The concept has improved our organization**

LAURENCE W. COLLINS, Jr., Associate Editor

WHEN the National Machine Tool Builders' Association Exposition comes up this fall, visitors can expect to see emphasis on Numerical Positioning Controls. They'll see NPC machines perform unbelievable miracles with sophisticated electronics controlling various types of machine tools. But don't let the mysteries of electronics panic you.

Possibly numerical positioning control will be regarded, in years to come, as having had greater impact on metalworking industries than any other single development. As with every new development, NPC (also called tape control) has its champions and it has opponents.

The electronics and mechanics of NPC systems have been found by many to be relatively simple compared with the side effects to organizations which have gone into tape control without the proper understanding of the over-all concept.

The questions in the minds of many alert prospective users of NPC are these:

1. Can my shop really use NPC and make money?

2. How do I know what equipment is right for me?

3. Do I have to buy a computer to go with it?

4. How do I get started in a small way to see whether I like NPC?

5. How is NPC going to affect my company?

6. How good is a retrofit (existing machine to which NPC has been added)?

7. Is part design affected by NPC?

8. Does numerical control affect tooling?

9. Does numerical control affect production scheduling?

10. Where will numerical control affect our staff organization?

11. How do we organize for numerical control?

Here are the answers in correct order.

Q. 1. Can my shop use NPC to make money?

A. If you have short runs in metal cutting and point-to-point dimensions are important, you can usually make money with digital-control systems.

There are few applications envisioned at present for automatic control in high-production, transfer type equipment. Instead, numerical controls are most effective when handling lot sizes from 1 to 500 pieces, and where engineering changes are frequent and costly, or where raw-material-inventory costs and storage-space costs are problems. Under tape control, for example, you change the paper tape rather than rework an expensive fixture to handle an engineering change. Flexibility plus repeatability is the keynote. Users report significant reductions in scrap losses and rework. This is because the tape pro-

gram can be checked on a dry-run before ever touching metal with a tool. The machine works from the original data without cams or tracers. Results are reproducible.

It is possible to start by converting a drill press to numerical table positioning at moderate cost. However, the experts warn that the simplest tape-controlled machine must be taken seriously. It's not just another machine tool. Numerical positioning, to be properly turned into an asset, must be correctly selected, staffed with specially picked personnel (properly trained and oriented as a team). They must be backed with the proper staff organization and management concepts.

The Warner & Swasey Co., Cleveland, Ohio, now has a Milwaukee jig borer, Fig. 2, a DeVlieg Jigmil, Fig. 3, and a Milwaukee-Matic, Fig. 4. All have tape controls, and the company has scheduled over a dozen more Jigmils for conversion to tape control by retrofit. As far back as six years ago, the company decided it was going to have to live with tape control. Now its shop is using machines that are converted to digital systems. W & S has a subsidiary that builds the Teleprobomat control; it is also delivering its own brand of machines converted to tape-control systems as original equipment.

The Milwaukee-Matic has General Electric control as original equipment; the jig borer and Jigmil have Teleprobomat controls as retrofitted (conversion) equipment.

Warner & Swasey makes production profits because of numerical control installations and the know-how from six years of analyses and preparation. This includes:

1. Preset tooling;
2. Job studies;
3. Standardized tool grinds;
4. Improved fixturing;
5. Purchase analysis for uniformity (castings);
6. Use of industrial engineering job studies for data preparation and programming;
7. Management encouragement in selection and training of personnel; and
8. Staff organization and system improvements to accommodate NPC in the most efficient manner.

Q. 2. How do I know what equipment is right for my production job?

A. Shop around, study control systems. Here is where you'll discover that you're not buying just another machine tool. Assign a competent key man to do your shopping. Or do it yourself, if you're the boss. Selection of equipment and organization for profitable use is a big job with much at stake. There are fifty or more systems available, each with its own individual advantages and merits for special cases.

Call on management people now using numerical control systems. Ask each one how he arranged his concepts and organization for digital-control systems. Ask about the side-effects of tape-control systems.

Q. 3. Do I have to buy a computer for programming my tape-control system?

A. No. The trend is toward the use of data processing centers for the most complex work. Most machine programs can be prepared for point-to-point systems in a single plane using a Friden Flexowriter automatic typewriter or its equivalent. Companies owning their own computers are usually working on continuous path contour programs. In addition, computers are used for payrolls, engineering data processing, production control, as well as tape programming.

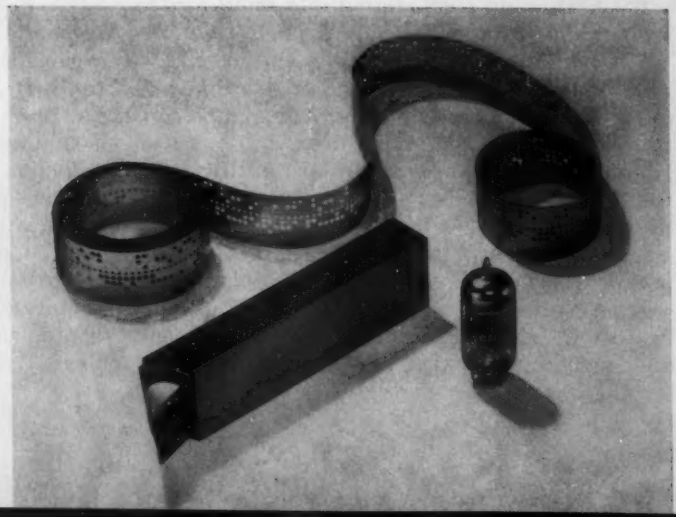


Fig. 1. Symbolic of numerical positioning control are the punched tape, the electron tube, and a cutting tool. Working as a team in the proper organization climate, NPC is a potential profit maker.

Fig. 2. Tape-controlled Milwaukee jig borer was converted from manual control to the operation of NPC systems and organization as a trial venture. The Teleprobomat control (on the right) programs the automatic milling of cams.

Sometimes the processing of engineering data can be combined directly with machine tool programming to save intermediate operations. Market research studies by reliable machine tool builders forecast that at least 85 to 90 per cent of the tape-controlled installations will be point-to-point systems. Most of the remaining 10 to 15 per cent will involve continuous path contouring, such as spar-milling. Tape preparation services are available at data processing centers. A small fringe number of highly sophisticated systems will be used for true three-dimensional work; for instance, die-sinking, still in the debugging stage. In most cases, ownership of a computer is not required—at least in the initial stages.

Q. 4. How do I get started in a small way to see whether I like NPC?

A. In the first place, if you do small lots involving accurate point-to-point positioning, tape control will likely become a must for you sooner or later. Either costs or competition can drive you to it. Getting started in a small way can be done by retrofitting (converting) one of your existing machines, such as a production drill press. Selection of your new NPC equipment is going to be only as good as the hard selection work, insight, know-how, staff organization, and management understanding behind it. So start out with a numerically positioned table under a drill press and work up from there if you want to begin modestly. But remember that you'll need the same insight, organization, and concept for a modest investment in digital systems as you would for a big one.

Q. 5. How is NPC going to affect my company?

A. This is relative. It depends on your organization and your company's degree of efficiency. If efficiency is low, a digital-controlled system may look great at first because it is designed for efficiency. But be careful that the inherent efficiency of the control doesn't dribble away in losses blamed on the system, which is not really responsible. In some cases, if you have a highly organized, efficient organization, numerical control may have a harder time showing a profit. Yet profits will come through for you because flexibility, accuracy, savings in man-hours, and reduction of rejects are bound to reflect from the greater efficiency of the equipment.

You will most likely have to make a number of adjustments in your concepts and organization, regardless of how efficient your present operation. The reason is the amount and high degree of preplanning needed in all supporting departments.

In any case, the organization for efficient NPC systems work is likely to be beneficial to your whole operation.

Q. 6. Can I fit NPC to machines I already have in my shop?

A. Yes to this one, but with certain reservations. Numerical control can be fitted to most machine tools, such as drilling machines, jig borers, engine and turret lathes, horizontal and vertical boring mills, gear shapers, spot welders, and other standard equipment when they meet certain standards of accuracy and power, and possess the ability to use the new tool materials.

The practicability of retrofitting is extremely controversial. Your own judgment must provide your own answer.

The control system you buy affects the accuracy you can expect when you retrofit a used machine—or a new machine, for that matter. Some systems control the lead-screw; hence the condition of the lead-screw is critical. Other systems (for example, Farrand Inductosyn) work independently of the lead-screw. The control system does not improve machine accuracy. It can only set the stage for good repeatability.

Retrofitting can take another form: application of NPC by the builder to a new machine tool not specifically designed for automatic controls. Tape controls are substituted for manual and mechanical controls, such as stop-bars, cams, tracers, limit switches, and similar controls.

Now, of course, there are machine tools on the market designed around numerical positioning.

Retrofitting is regarded by many as a pilot or experimental type of operation in which a machine is equipped with tape control, then tested to see whether the system works and produces acceptable parts. This approach has merit in case management has doubt regarding the mechanical performance of the equipment. However, a true appraisal of the over-all concept requires an understanding of the changes in part design, procurement of raw material, production scheduling, and staff organization and concept which inevitably enter the picture if you are to achieve full economic benefits.

At this time there are only a handful of numerically positioned machine tools that can be bought off the shelf. Consequently, when your requirements fall outside the range of available stocked machines, retrofitting may be the only way you can get the results you want.

Q. 7. Is part design affected by conversion of machines to numerical control?

A. Here are some fundamental rules. They apply generally to anything that has to be machined.

1. Keep design as simple as possible. This has always been the watchword in machining, but it is even more important with automatically controlled machine tools.

2. Simple design results in lowered fixturing and tooling costs; makes a better product that is easier to hold; is less expensive to work.

3. Irregular shapes with nonuniform and abrupt changes in the cross section lead to unpredictable part responses. These should be avoided.

4. Provide maximum cutting tool accessibility in part design so that the greatest possible number of operations can be combined in a single fixturing and tool setup.

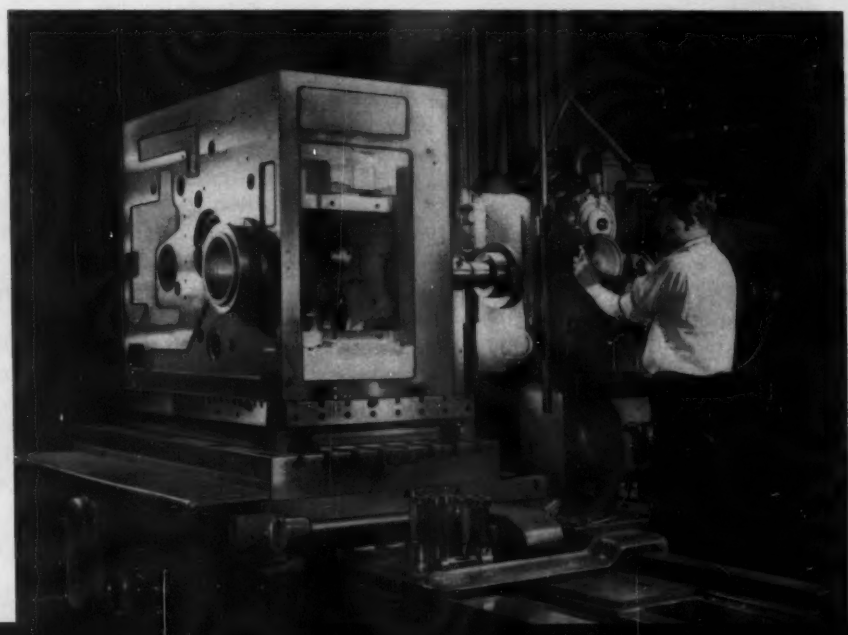


Fig. 3. Precise point-to-point positioning of short runs gives this tape-programmed DeVlieg Jigmil an ideal job in boring with preset tooling. The company plans to retrofit similar machines with tape control.

Q. 8. Does numerical control affect tooling?

A. Let's put it this way. If tape control *doesn't* affect your tooling, something is wrong. Here are a few observations based on Warner & Swasey's experience:

1. One of manufacturing's first principles is: For the greatest productivity, run any machine tool *all the time*. Raw material (castings), tapes, jigs, gages, fixtures, and preset tools must be ready in a *package*, preplanned to drop into the machine immediately. Preset tooling is a must. Warner & Swasey developed a whole new tool storage, tool inventory, tool sharpening, and tool presetting system for its tape-positioned machines, Figs. 5, 6, and 7. The new tool system plays an important part in making digitally positioned operations successful. Incidentally, it improves all other conventional tooling systems.
2. Simplify tooling and fixturing.
3. Holding reference surfaces on work-pieces should be milled or ground as a preliminary operation.
4. The reference surface should be fixtured, as it will be held in its end use, eliminating the possibility of distortion.

Q. 9. Will a switch to numerical control affect our production scheduling?

A. Numerically controlled systems demand a continuous, steady work flow in order to justify their existence. They roll out lots of good work. Parts must be kept moving to and from the machine continuously. In a high-volume industry steady feed and flow of work is easy to get. But in a small-lot, high-variety industry where tape control offers greatest advantages, the problem of work flow can become complex.

Although at first the volume of various parts may appear ample to keep the tape-controlled equipment busy, the day-to-day work load may vary from severe overload to no load at all unless advance planning balances the work flow. Obviously such advance planning and production programming are functions of the production scheduling and control operations in the organization.

Compromises in procurement and manufacturing lead-times may become necessary. Attitudes, with respect to the cost of in-process inventory and the cost of finished-parts inventory may have to be adjusted. It should be noted that uneven work flow is a perennial problem which industry must solve whether or not numerical control systems are involved. The presence of tape-controlled equipment only emphasizes the need for overcoming the problem.

These are but a few examples of the more obvious and general areas where you can expect problems and the need for adjustments in making NPC systems workable.

Q. 10. Will the introduction of numerical control affect my company's staff organization?

A. Yes, because staff, in general, is a planning function from which flow the operating plans used in the manufacture of the product. As previously emphasized, the most important prerequisite for successful use of numerically controlled equipment is complete and thorough planning. Therefore, every effort should be made to organize the staff in a way that assures operating procedures meeting the needs of the automatically controlled machine. The most noticeable changes are likely to occur in the organization and responsibility of your industrial engineering department.

Details of the planning will vary according to the size and nature of the business, and according to the nature of the total organization. Of the highest importance is the capacity for coordinated action. The activity of the various staff functions must be so organized as to result in a fully integrated plan. Tooling must reach the tape-controlled equipment in question according to schedule. Every detail of every action, plus every eventuality, must be preconceived and integrated into the control instructions, preferably in a standard coding or tape language.

Industry, at times, seems to have taken the attitude that digitally controlled systems substantially increase staff personnel, thus cancelling a large share of the possible savings. However, Warner & Swasey found no staff increases necessary as a result of introducing numerical positioning.

This is because the company analyzed the probable effects of numerical system control and anticipated its requirements. Then it made staff and procedural adjustments, thereby effecting advanced planning, definition, and integration of production functions necessary to make the switch to NPC relatively easy whenever the actual equipment went into production.

Q. 11. How do we organize for numerical control?

A. Each company's problem will differ as to the details. Only analysis, insight, and planning provide the answer. Experience shows that halfway measures seldom bring success and profits. The NPC concept requires a broad, sweeping ap-

proach. Without an all-out approach, results from applications of automatic control may prove disappointing. Organizational weaknesses become amplified. As stated before, numerical control forces the manufacturing preplanner to determine methods *before* the job is performed, thereby taking methods away from the operator. With the aid of reliable, accessible, and simple standard data, the preplanner can easily determine the best method and sequence of operations before the job is released to the shop.

Working directly from the part print, the preplanner uses standard-time data for determining best sequence of cuts. He compares alternate methods for selection of the proper cutting tools that will operate at optimum speeds, efficient chip loads, and give the longest tool life.

Since manufacturing policies and procedures in many shops are directly determined by engineering requirements, the first step in advance planning may be basic considerations in the study of surface roughness and the definition of surface quality. Proper standard data cannot be established without first clearly defining engineering surface quality requirements.

From the example above, it is obvious that the manufacturing preplanner becomes the key employe in the successful application of numerical control to machine tools. He establishes the effectiveness of the entire system. To make proper decisions, he must have a thorough knowledge of manufacturing methods, tooling, standards, and metal-cutting technology.

Standard data can speed the education and development of the preplanner by helping him acquire a better knowledge of feeds, speeds, and the behavior of materials and tools. Because he must have a higher order of skill than is commonly found in industry, an alternative is to use a process planner, supported by a tooling-and-standards team.

The type of planning needed to meet the concept of NPC is really nothing new. Actually it is nothing more than the serious application of

Fig. 4. Designed around numerical positioning control, this Milwaukee-Matic features automatic tool changing from the circular turret magazine in the center. While one casting is being automatically machined in the pallet fixture on the index table, operator clamps the next job in a fixture on the alternate pallet for the next cycle.

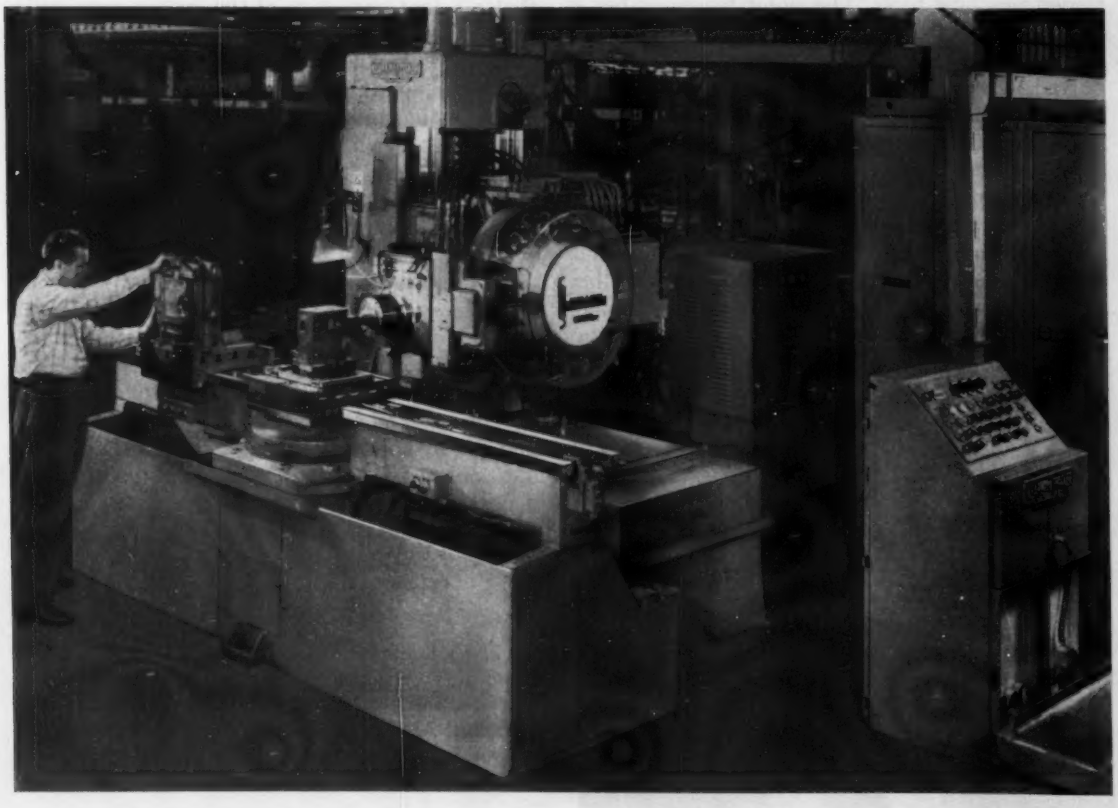


Fig. 5. Presetting a boring tool for a Jigmil. Setup time for the Jigmil is thereby minimized and production time is increased proportionately.

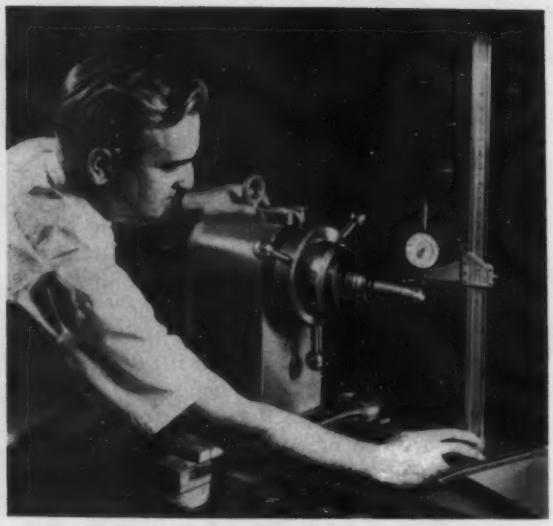


Fig. 6. A special adapter-holding fixture speeds up the presetting of cutting tools for the tape-controlled Milwaukee-Matic machine.

sound management principles widely used for well over sixty years. They are proved, profit-generating principles and procedures recommended whether or not you use numerically positioned machine tools. The point to remember is that tape control brings efficiency. But to be profitably operated, digital systems must be supported by the thorough planning that represents operating efficiency.

In operation, numerical positioning has been characterized by its persistence in throwing the spotlight on whatever weaknesses or inefficiencies there are in operating organizations. Machines are not subtle. Consequently, studies that precede the purchase of digitally controlled equipment should include more than the important, but relatively simple, appraisal of how the equipment works, and whether or not the mechanics of the setup will do the physical job needed. Rather, the acquisition should be approached with insight and the full realization that efficient operation of the system may easily bring in with it a new way of life for parts of your organization. You can look for more than just direct labor savings, if you organize correctly.

Top management is likely to have to do some soul searching in applying NPC to its organization. The more management plans in advance, the less drastic will be the over-all adjustments needed to show the profits that can be expected from the efficiency built into the equipment.

Be prepared for the likelihood that staff personnel may have to be retrained or staff specialists added for work in the organization to introduce the concepts and techniques needed for numerical control systems. However, conscientious management analyses will reveal that the changes in concept, staff, and methods are not additions at all. Actually, they will be corrections of past omissions already long overdue.

Fig. 7. Tool-adapter shank mounts a stack of washers of two different outside diameters. By varying the profile of the stack according to a code, the presetter can program the sequence by which the magazine turret of the Milwaukee-Matic automatically selects tools and inserts them in the spindle.

AGMA ACTIVITIES AT HOT SPRINGS

(Left to right) James F. Murray, president of the American Gear Manufacturers Association; Charles F. Bannan, vice-president, product division; Folke Richardz, vice-president, technical division; and J. H. Harper Jackson, treasurer. E. J. Wellauer received the Edward P. Connell Award.

The forty-fourth annual meeting of the American Gear Manufacturers Association was held at the Homestead, Hot Springs, Va., from June 5 to 8, inclusive. Both trade-association and technical meetings were well attended, as well as the many committee meetings devoted to different phases of the gearing industry. Of especial interest was the presentation of a proposed new classification manual for spur, helical, and herringbone gears. Various changes were suggested. It is expected that an improved manual will be available in the near future. This meeting was under the chairmanship of C. R. Burrell of the Tool Steel Gear & Pinion Co.

E. C. Beaudet, managing editor of *Iron Age*, presented a paper entitled "Capital Appropriations." He discussed the spending plans of thirty-seven industries and foreshadowed a high level of spending for capital goods during the present year. E. J. Tangerman, editor of *Product Engineering*, read a report on the European common market. This report was based on personal interviews with economists and business executives in countries belonging, and not belonging, to the common market. The speaker commented that the common market may finally form the basis for a United States of Europe.

Louis D. Martin, gear consultant, spoke before the fine-pitch gearing committee, stressing the phenomenal growth in the application of fine-pitch gears during the last twenty years; he pointed out design considerations at variation with those for coarse-pitch gears. Mr. Martin specifically discussed total composite error, pinion enlargements, and the desirability of pressure angles greater than 20 degrees.

A paper, "Make or Buy," was presented by C. B. Adams, manager of purchasing services, General Electric Co. The Edward P. Connell Award was presented to E. J. Wellauer, director of research and development, the Falk Corporation. The award speech was made by M. R. Anderson, president of the Michigan Tool Co.

Officers elected for the current year are: president, James F. Murray, president, Winsmith, Inc., Springville, Erie County, N. Y.; vice-president, products division, Charles F. Bannan, vice-president, Western Gear Corporation, Lynwood, Calif.; vice-president, technical division, Folke Richardz, consulting specialist, gearing products, Westinghouse Electric Corporation, Buffalo, N. Y.; and treasurer, J. H. Harper Jackson, sales manager, Jackson Gear Co., Pittsburgh, Pa.

New directors are: Sanford M. Brooks, Walter W. Trout, J. S. Gillispe, E. V. Rankin, and F. A. Smyth.

Moderators at the Production Machine Tool Hydraulic Conference were Nevin Bean (left), Automatic Transmission Division, Ford Motor Co., and R. C. Montanus (right), president, Springfield Machine Tool Co.

FOURTH PRODUCTION MACHINE TOOL HYDRAULIC CONFERENCE

"PRODUCTIVITY must keep pace proportionately with labor costs if American industry is to remain competitive with overseas competition." This statement was made by A. C. Mattison, president, Mattison Machine Co., Rockford, Ill., and president of the National Machine Tool Builders' Association, in the keynote address before the Production Machine Tool Hydraulic Conference in Detroit, Mich., May 17 and 18. The annual gathering, fourth of its kind, was sponsored by the Vickers Division of Sperry-Rand Corporation.

Mr. Mattison's theme was: "Our High Cost Problem." Stressing his point, he said: "Because of upward spiraling labor costs, and the resulting economic dislocations, American machine tool builders are being priced right out of the export market." Many machine tool builders, because of high labor costs in America, have been forced to start overseas operations to compete with foreign companies in the world-wide market. Overseas operations are undertaken to prevent cheap imports into our domestic and overseas markets. "Unless productivity increases we lose the advantages of our technological improvements," he declared.

Moderators for the panel sessions at the conference were: Nevin Bean, Automatic Transmission Division, Ford Motor Co., and R. C. Montanus, president, Springfield Machine Tool Co. Highlighting the conference was the presentation of four papers by users of hydraulic systems. Short prepared discussions, by members of Vickers' engineering staff, answered specific questions solicited in advance from the guests.

F. E. Fiedler, Chevrolet-Buffalo Division, General Motors Corporation, read a paper on "Control Systems and Human Elements as Applied to Preventive Maintenance." According to Mr. Fiedler, success of hydraulic systems in high production plants is vitally dependent upon good machine maintenance control based on a well-engineered record system. Cooperation from management must be complete for beneficial operation of the system. Detailed record systems form the basis of regular machine maintenance operations. They pay off handsomely by avoiding production breakdowns, by saving hydraulic oil, and drawing attention to persistent trouble spots.

H. G. Hauck, Sperry Gyroscope of Canada, spoke on "Application of Numerical Control to Machines Using Linear Actuators." He described a novel tape-controlled machine tool and numerical control system (designed by his company) that make use of hydraulic actuators for precise linear motion of the slides. Accuracy is on the order of 0.0001 inch on two coordinates. The

control system feedback is a combination of mechanical rack-and-pinion for coarse resolution and electrical inductance for fine resolution at extremely rapid rates. The entire equipment has an excellent reliability factor.

The paper delivered by Mr. Ben Welte, technical director, Colonial-Romulus Division, Colonial Broach & Machine Co., was on "Hydraulic Adjustable-Speed Spindle Drives for Contour Milling Machines." Two special contour-milling machines, using different hydraulic spindle drives, were built by his company for an aircraft company's research laboratory. The purpose was to study the cutting characteristics of materials of aircraft construction. The machines used dramatically different hydraulic systems to achieve a great range of spindle revolution rates, demonstrating high efficiency. Mr. Welte contrasted hydraulic with electric spindles in respect to weight, space, speed variability, spindle direction reversability, and start-and-stop characteristics.

Filtration, cooling, and heating of hydraulic fluid were described and illustrated by R. R. Thoren of Vickers. His paper, "Proper Conditioning of Hydraulic Fluids," treated the three phases of his subject broadly, covering historical facets, present practices, and industrial trends in the light of the needs of hydraulic equipment builders and machine tool builders as users. Because of increased system working pressures, filtration must remove finer and finer soil particle sizes. Every hydraulic system should be filtered, and these filters must be regularly inspected and serviced, in accordance with the demands and conditions under which the system is used. Cooling is more often needed than heating. Hydraulic systems are being designed in greater numbers with cooling systems in them for optimum performance.

Expanding applications for hydraulics and controls are challenging the ingenuity of the producers of the equipment. They must satisfy fringe requirements to assure growth. Some potential users want extremely low pressures, such as 20 psi, and speeds down around 50 rpm on spindles. Others want 5000 and 6000 psi and 5000 to 60,000 rpm spindles. With these broadening demands for fluid-driven motors come demands for pumps to drive the motors, plus the various valves to control the circuits.

Vickers exhibited a number of practical examples of systems and circuits to show applications. One in particular demonstrated linear and rotary actuation by hydraulics with precise digital control. Their engineers described a number of pieces of new equipment and valves that will soon become commercially available in answer to indicated trends. New power packages, new miniaturized solenoid valves, and a new check valve are included.

The discussions of the panel sessions covered every phase of hydraulics affecting machine tool applications. Most machine tool builders are receiving and giving excellent cooperation in the establishment of Joint Industry Conference Standards for hydraulic equipment. Several informal speakers at the meetings voiced the hope that equally complete cooperation would soon be forthcoming from the electrical industry for JIC equipment standards.

New Electromechanical Laboratories

New laboratories have been added to the research center of the United States Steel Corporation at Monroeville, Pa. These laboratories are dedicated to the development and application of control systems for new and existing processes in all steelmaking functions and to the search for better methods of controlling the chemical and metallurgical properties of products.

Employing radiation devices to determine temperature changes in a small model of a blast furnace, in the new electromechanical laboratories of U. S. Steel.

Broach Pulls Square Holes for Fuel Injection

SQUARE HOLES by the hundreds are not an uncommon demand in the shops of the B. H. Aircraft Co., Inc., in Farmingdale, N. Y. One particular job of this type is a thrust-chamber flange for a Pratt & Whitney missile engine which requires ninety such holes around its periphery to serve as fuel-injection ports. The detail is a ring-shaped forging of Type 347 stainless steel that measures 13 inches in diameter and has a wall thickness of only 1/8 inch.

Preliminary machining brings the forging to proper configuration. After that, the part is locked in an indexing drill jig and the ninety holes, each 0.281 inch in diameter, are drilled through the wall.

These holes are all located within a tolerance of 0.005 inch from a flanged face of the workpiece. Located radially every 4 degrees, the holes have a true position tolerance of 0.010 inch around the part. A third factor is involved. The radial axes of the holes are inclined at an angle of 8 degrees from the horizontal, as noted in Fig. 1.

Once drilled, the ring is fitted into a specially constructed fixture (Fig. 2) for squaring of the holes. This is done with the portable Chicago Pneumatic broach puller shown in Fig. 3. The square broaching tool is 8 1/2 inches long and measures 0.281 inch across the flats at its finishing end; therefore there is no change in hole diameter, only in shape.

A swinging angle arm on top of the fixture has a guide hole for the tool and a concave support block for the end of the puller on its downturned leg. This leg forms an included angle of only 82 degrees with the arm so as to provide the re-

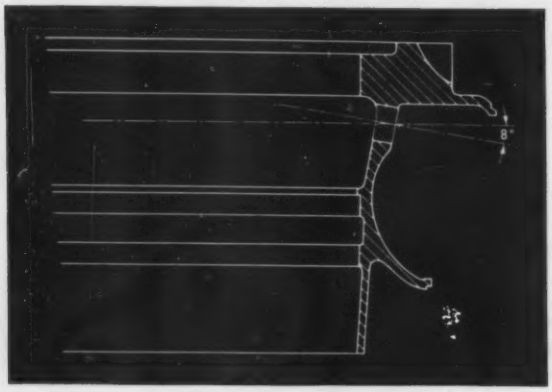


Fig. 1. Cross section of forged stainless-steel thrust-chamber flange for missile engine. Ninety fuel-injection ports pierce the 1/8-inch-thick wall at an angle of 8 degrees from the horizontal.

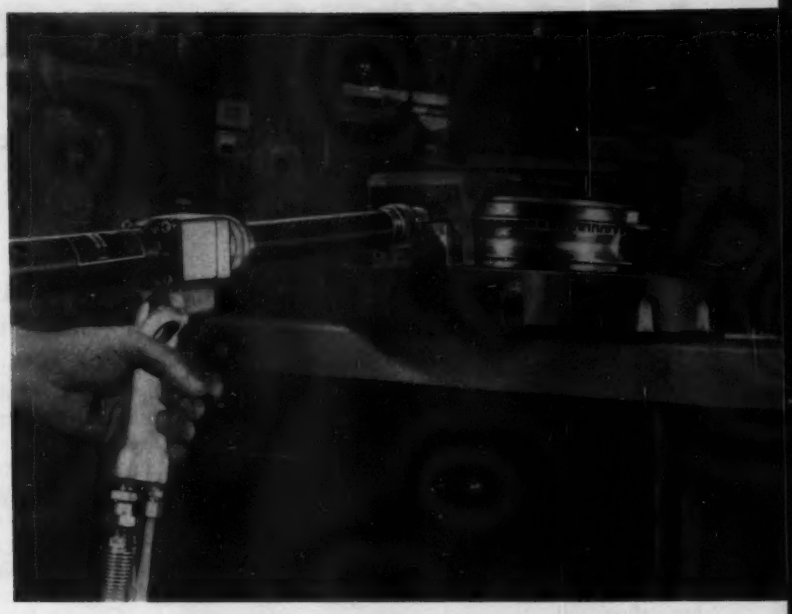
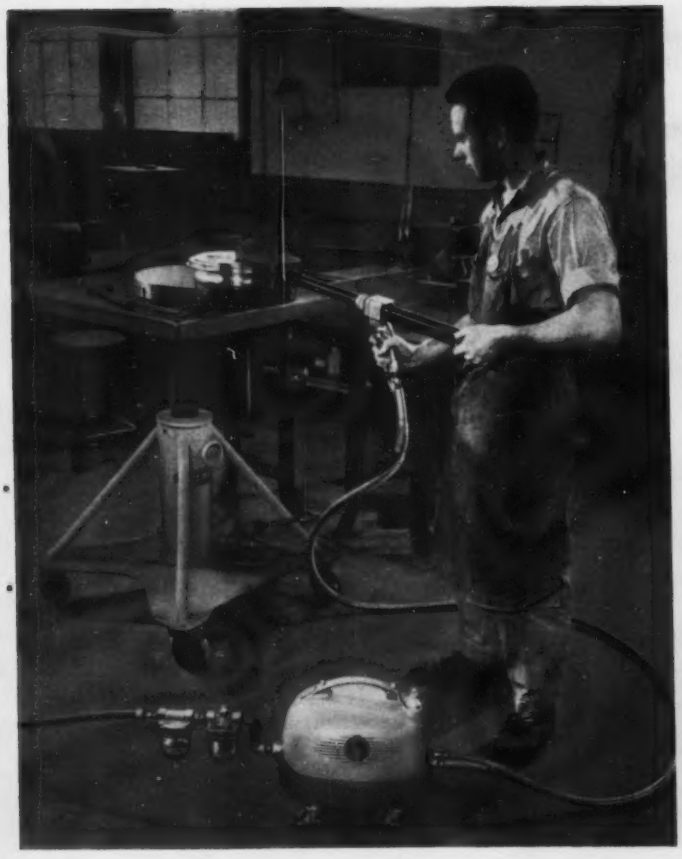


Fig. 2. Fuel-injection ports are first jig-drilled, after which they are locked up in this fixture. Portable broach puller forces square broaching tool through one drilled hole at a time.

Fig. 3. Portable power cell on floor in foreground supplies tool cylinder with oil for broaching stroke. Air powers return stroke.



quired 8-degree slope for walls of the square ports.

The tool is slipped into an inclined groove in the upper surface of the angle arm. This groove guides the tang end of the tool through the drilled hole in the work-piece (from the inside of the wall to the outside) and through the guide hole in the fixture arm. With the tang thus protruding, the nose of the broach puller is placed over it. When a trigger on the portable gun is squeezed, a chuck engages the tang of the broaching tool and pulls it through the hole.

A completed thrust-chamber flange and the square broaching tool used on it can be seen in the heading illustration. The entire operation—including setup, broaching, and manual repositioning for each hole—takes approximately three hours. Since B. H. Aircraft started the broaching operation, not one flange has been rejected.

Hydraulic Portable Broaching Gun Operated by Shop Air Pressure

For this application a CP-659 broach puller is used. This tool has an automatic chuck, a stroke length of 9 inches, and exerts a pulling force of 5500 pounds (other models go as high as 11,000 pounds). A 60-pound, air-operated power cell (bottom, Fig. 3) provides the necessary hydraulic power for operating the broaching tool. Using normal 90-psi shop air pressure, the power unit supplies as much as two quarts of oil at pressures up to 7000 psi to the tool cylinder for the one-shot broaching stroke. Low-pressure air is used for the return stroke.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Machines and Equipment Shown at Pratt & Whitney Centennial Celebration

To commemorate its one hundredth anniversary in May, 1960, the Pratt & Whitney Co., Inc., West Hartford, Conn., established a permanent display area known as "Centennial Hall" at its West Hartford plant. An exhibition of Pratt & Whitney machine tools, including many new developments, was an important part of the opening show at this celebration. Among the new machines displayed was the numerical-head jig borer, Fig. 1. In addition to automatic positioning of the table under the control of a tape-reading numerical system, this machine also provides fully automatic selection of spindle speeds and feeds, automatic rapid-traverse positioning of the spindle and quill above the work, and automatic control of the boring depth and cycle.

By extending numerical control to the operation of the spindle, this jig borer becomes a superaccurate machine capable of performing an entire series of precision machining operations automatically. The operator has only to clamp the work on the table, start the automatic cycle, and change tools when required.

Because of the many advantages of tape control, tapes are often prepared even for single-piece jobs. However, for the occasional jobs handled on this machine where use of a tape is not desired, positioning data for both table and spindle can be fed into the system manually, using the P&W "telephone" dial control. Like all of the company's numerically controlled jig borers, this machine has the superaccurate Electrolimit measuring system which is capable of locating work accurately to 0.0001 inch and retaining this initial precision indefinitely. The machine also incorporates the exclusive P&W "floating zero"— a feature that makes it possible for the operator to establish or re-establish the zero point for a machining job at any convenient location or reference point.

The Keller Model "C" BL milling machine with tracer control, Fig. 2, was also introduced at the opening of Centennial Hall. This horizontal spindle machine, with its improved construction, rugged spindle components, and greater weight than older models, provides for heavier milling cuts, greater speed, and better finish. Designed specially for tracer control milling, the machine will reproduce any two-dimensional template or three-dimensional model quickly and accurately. It will handle the most complex or irregular dies, molds, prototypes, and any other pieces that cannot be conveniently or economically machined by other methods.

The most important feature of this machine is the complete transistorization of all control circuits. The control data is fed to grids of each thyratron for each slide, energizing and regulating clutch speeds for continuous motor speeds. The motor speeds match their respective speed vectors at the point of

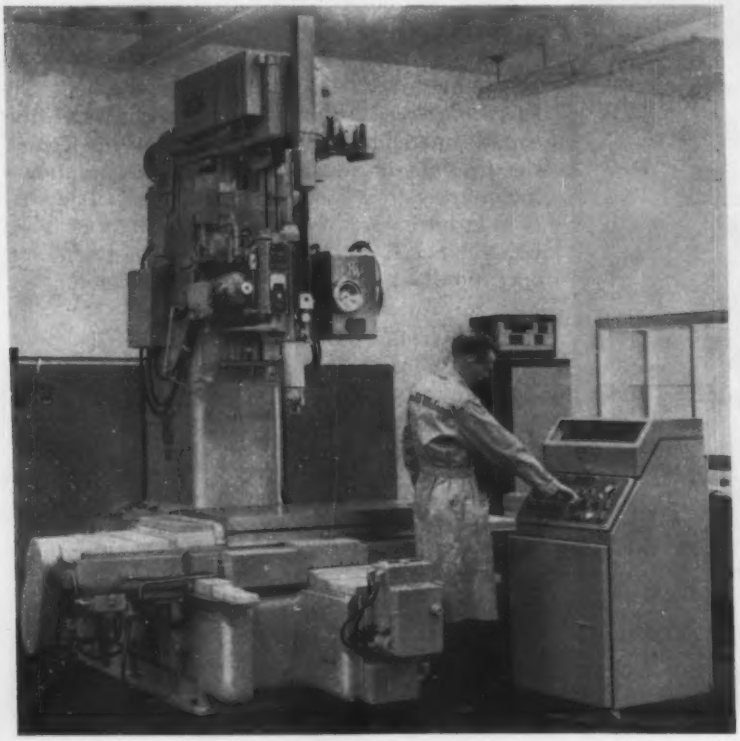


Fig. 1. P&W numerical-head jig borer displayed at Centennial Hall

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

tangency with the tangency of the cutter with the work (and tracer with model).

Because of added weight and rigidity, vibration and chatter have been eliminated, even with interrupted cuts. The 15-hp spindle motor, with timing belt drive, provides more than enough heavy-duty power. Spindle speeds range from 40 to 3600 rpm. All controls are located on one panel, and the machine is completely under push-button control. The tracer control circuit has faster response than previous controls, which in turn demands faster motor response of the variable-speed motor drives. Formica-lined slides are provided for better table and head control, and automatic lubrication insures smooth motion of all slides. Mist lubrication to the cutter-spindle allows bearing preloads necessary for heavy milling (15 hp at 40 rpm).

Another machine shown at the same time was the SIM 10-inch production lathe, Fig. 3, manufactured for Pratt & Whitney by the French firm, Les Innovation Mechaniques. This lathe is reported to deliver "toolroom" accuracy and extremely fine finishes. Equipped with a 7 1/2-hp motor and rigidly constructed, this lathe is designed to remove metal fast and take the heaviest cuts with ease.

In addition to its power and precision, this lathe also incorporates many features that contribute to speed and ease of operation, making it well suited for economical small- or medium-lot production. A single-lever control starts and brakes the spindle and opens or closes the air-operated chuck. Operating pressures for the chuck

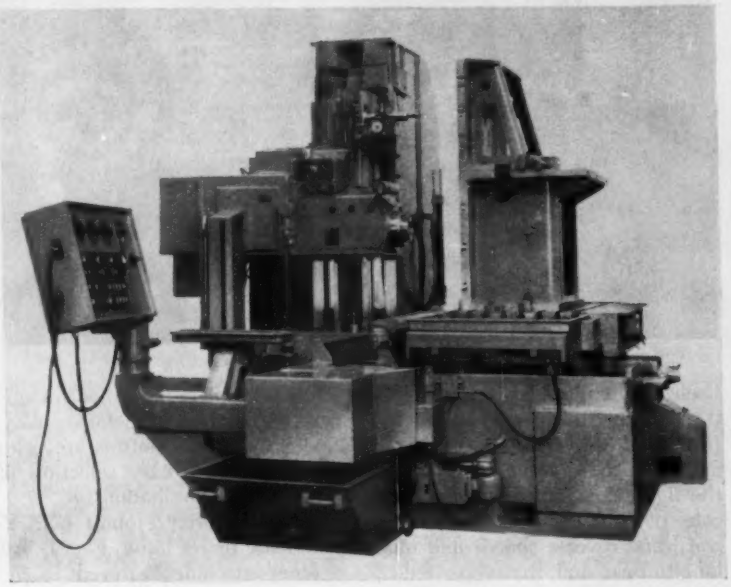


Fig. 2. Keller Model "C" BL milling machine with tracer control introduced at P&W show

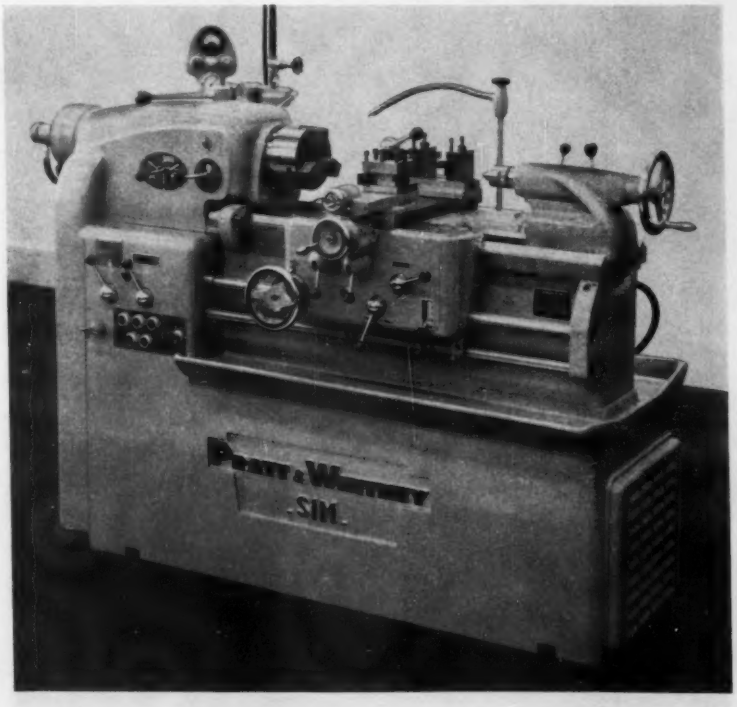


Fig. 3. P&W SIM 10-inch production lathe built to give toolroom accuracy

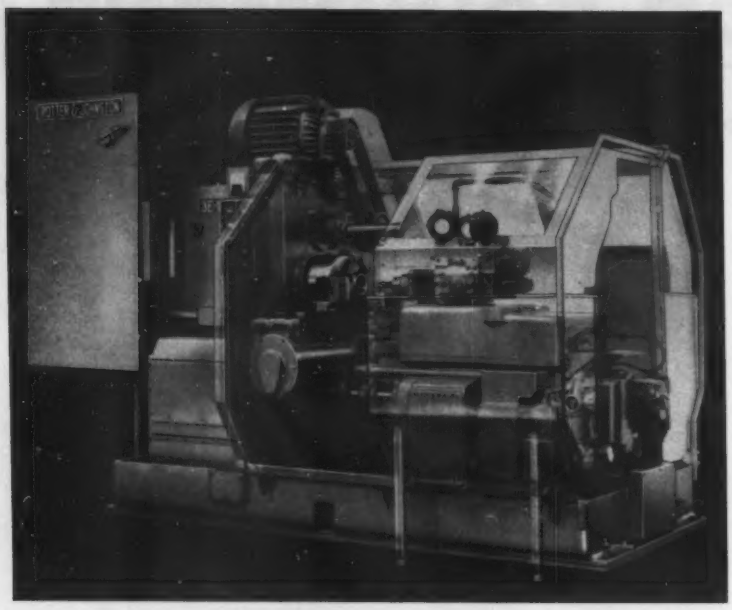


Fig. 4. Potter & Johnston 3E-15 automatic turret lathe featured at P&W centennial celebration

itself are infinitely adjustable from 0 to 22.5 pounds per square inch—providing the right pressure for any work from the heaviest cuts to the lightest cuts on the most delicate pieces. There are nine forward and reverse speeds and nine longitudinal and transverse feeds, affording the right choice for any type of cut in any metal or alloy. Speed and feed controls are color coded for fast, easy selection of the correct combinations.

The new Potter & Johnston 3E-15 automatic turret lathe, Fig. 4, was another machine featured at the centennial celebration. This 15-hp machine is designed for fast metal removal of the toughest superalloys and to give an excellent finish and high accuracy. The standard six-face turret is equipped with a heavy locking bolt. The turret is clamped and locked before advancing to the feed position and is automatically released at the start of the next index. The lubrication system has been centralized for easier maintenance. Self-compensating, electric speed and feed clutches are used to eliminate adjustment and maintenance.

A cross-slide control panel allows setting of all cross-slide movements by means of a selector switch for each slide. Either on-time or delayed motion relative to the turret motion can be set for front and back slides. Both slides may be operated either together or independently with any turret face.

There are four automatic speed changes for each set of speed-change gears (standard is 60 to 1540 rpm) and six feed changes for each set of feed-change gears. Feed range per spindle revolution is 0.002 to 0.162 inch. An extra-large control drum, designed for easy accessibility for setup, controls all machine motions, stop, start, rapid traverse, and speed and feed changes. Each lever has an appropriate label indicating its function.

Available as optional equipment is the Potter & Johnston tape control—a unique, low-cost, and easy-to-operate and program unit. Since this is an electric system, it requires no tubes or transistors. All motions of the spindle, turret, and cross-slides, including all speed and feed changes, are automatically controlled by a punched tape.

A new measuring instrument for analyzing threads, designed to meet the demand for supercritical threaded parts in space-age laboratories and industrial plants, was introduced at the P&W Centennial Show. Known as a "Helical Path Analyzer," this new instrument, Fig. 5, analyzes both linear and "drunken" deviation from the true

Fig. 5. P&W Helical Path Analyzer for precision checking of external threads

helical path of thread plug gages or similar precision threaded parts, such as those used in aircraft instruments and guided missile control and timing devices. It can check deviations to an accuracy of 0.00003 inch over three revolutions on external precision threads. The results are recorded graphically on a chart. Indexing is continuous and automatic.

The Helical Path Analyzer actually measures deviations in threads that up to now could not be accurately detected. It is suitable for use in gage laboratories and for making production analyses and for correcting thread gages or thread grinders. The analyzer has a work capacity of 8 inches between precision centers and a 6-inch maximum diameter. It can check all pitches and forms of threads up to 5 inches in length. Knowing the drunkenness in each turn of a thread, and the distance from turn to turn, the operator can quickly determine if the cumulative deviations fall within a given tolerance.

The work-piece to be measured is mounted between centers, and the motor-driven headstock rotates the part through three revolutions at one setting. At the same time, this rotary motion is transmitted to the chart drive of the recorder. Simultaneously, the driving ribbon running off the headstock actuates the sine bar laterally on a ball slide in direct proportion to the spindle rotation. The sine bar is preset to the proper helix angle for the particular thread being checked by means of special Hoke pitch blocks.

A line on the chart recorder graph represents the helical path of a thread for three turns of the work-piece. A thread having a theoretically perfect helix appears on the graph as a straight line through zero. Lead deviation appears as a straight line veering to either the plus or minus side, depending on the direction of deviation. A thread having drunkenness appears as a sine curve repeated over 360 degrees, since the pattern of drunkenness is usually recurrent in each turn. The chart drive is reversible so that superimposed duplicate readings may be taken.

Circle 565 on Readers' Service Card

Conveyorized Abrasive-Belt Grinding Machine

Thickness tolerances of plus or minus 0.001 inch can be held on a Mattison No. 458 conveyorized, abrasive-belt grinding machine with diamond-shaped head that "flexes" the belt as it drives. This machine, manufactured by Mattison Machine Works, Rockford, Ill., is now being used in the aircraft industry for high-production grinding of honeycomb. It is said to be unusually accurate for an abrasive-belt machine and ideally suited for finishing honeycomb, sheet stock, small parts such as motor laminations, and similar high-production flat work to critical thickness tolerances. Positive grain penetration is achieved through a combination of high horsepower on the belt drive and the diamond head design. Four rollers in the diamond-shaped head continuously "flex" the abrasive belt to keep it clean, cool, and free-cutting.

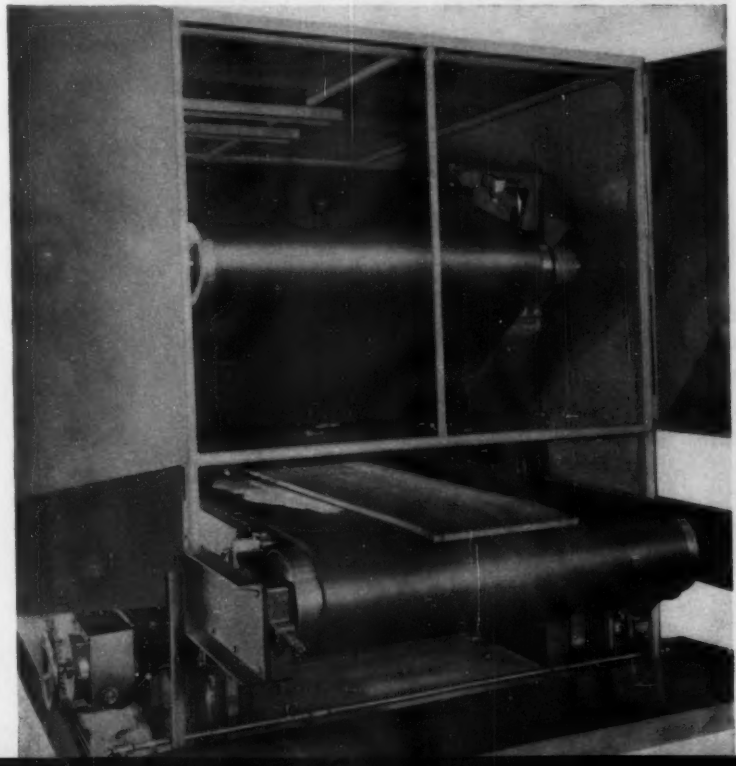
Each of the four rollers has a special function. One roll aligns the belt, one drives it, and another supplies grinding pressure. The fourth is an idler that provides additional belt flexing to prevent loading and to increase stock removal per square inch of abrasive belt surface. Separation of the contacting and driving functions prevents transfer of motor pulsations to the work, thus producing fine finishes. The use of four rolls avoids "wrapping" of the belt on the contact roll. The resultant flat angle of attack permits the belt to conform more closely to the uneven surfaces of the sheet.

This versatile grinder accommodates a 36-, 48-, 60-, or 72-inch belt, making it possible to grind large sheets or multiple small parts in one or more passes, depending on stock removal. Small parts of any size may be ground because the work is held on a rubber conveyor supported by rollers.

The conveyor bed is counterbalanced at each corner by air cylinders and is fed up into the contact roll by six precision screws. Actuation of the screws is precisely synchronized from a common drive, assuring absolute parallelism in both directions. Rapid traverse of the bed up and down may be controlled by push-button or manual handwheel. Automatic upfeed increments of from 0.0002 to 0.0005 inch per impulse are available to compensate for belt wear or change in work size.

Circle 566 on Readers' Service Card

Close-up of Mattison abrasive-belt machine used for grinding honeycomb



Machines and Equipment Introduced by Warner & Swasey Co.

A 25-inch swing "Servofeed" numerically controlled turret lathe, featuring an electronic "memory" system, is one of several recently developed machines announced by the Warner & Swasey Co., Cleveland, Ohio. The memory system of this lathe is designed to store and recall operational commands of any setup. The machine, shown in Fig. 1, is completely electrically controlled. Its built-in memory system can assimilate up to ninety-six consecutive commands, each command handling any machine function such as change speed, start rapid traverse, etc. Equally important, any command contained in the memory system can be changed at any time without disturbing other commands. Corrections in the memory system in a horizontal direction of 0.0005 inch, and in a cross direction of 0.00025 inch, can be made.

Operation of the memory system requires no tape or other outside programming. The operator simply presses a button at the end of an acceptable cut during set-up. Actuation of the button causes pertinent factors such as the feed, speed, start of cut, length, and dimension on the work to be automatically inserted into the memory system in the form of commands. These commands can then be used to control machine operation automatically on succeeding pieces.

An incremental tape path-control system, used exclusively for contouring, supplements the basic memory control of the lathe. Here the memory system, which is "absolute," is used to establish the precise starting point of the contour. When the machining cycle progresses up to that point, the memory unit automatically cuts in tape operation, and the machine proceeds with the contour in correct orientation to other dimensions. Since the memory is absolute, the tape contour can be referred to an established position at any time to maintain accurate relationships. With this control arrangement it is claimed that no tool drift or accumulated electronic losses can affect the position of the contour on the work. Thus the location of the contour is always exact in relation to all other cuts.

Of special interest is the provision for changing individual commands. For example, should an alteration be required in a setup, such as a cutter adjustment for tool wear, the change can be made without affecting any other commands. This quick-change flexibility of the memory system also permits the setup man to make small corrections for final settings to obtain proper chip action, etc.

The entire machine has been specially designed to meet the needs of numerical control. For example, the bed, bedways, cross-slide, saddle, and turret are inclined rearward 20 degrees from the vertical. A cross-sliding, offset pentagon turret is used. Tools are mounted on the turret face, parallel to the bedways. The turret is equipped with a coupling designed for accurate indexing, and is mechanically indexed through electric power. The headstock is hydraulically shifted and is powered by a 60/30-hp, two-speed motor. The head is equipped with two control panels--one is for setting up the job and the other for control while operating. The operator's control console can be moved along the front of machine to any desired location.

There are no handwheels or conventional micrometer dials anywhere on the machine. During set-up all machine elements are electrically controlled directly from the console. The servo-control levers for the cross-slide and cross-sliding pentagon turret actuate these elements, when in rapid traverse, in the same direction as their respective levers are moved and at a speed proportional to lever movement. These servo-levers permit the operator to advance tools toward the work slowly and with care, yet he can withdraw the tools in rapid traverse at a high rate of speed.

Slide-position dials take the place of regular micrometer dials and indicate accurately the change in position of each slide. Longitudinal dials read 0.200 inch per revolution and are graduated in 0.001-inch increments. The cross dials read 0.100 inch per revolution and are graduated in 0.001-inch increments. Each dial can be read to 0.0005 inch.

Fig. 1. Warner & Swasey Servofeed numerically controlled turret lathe

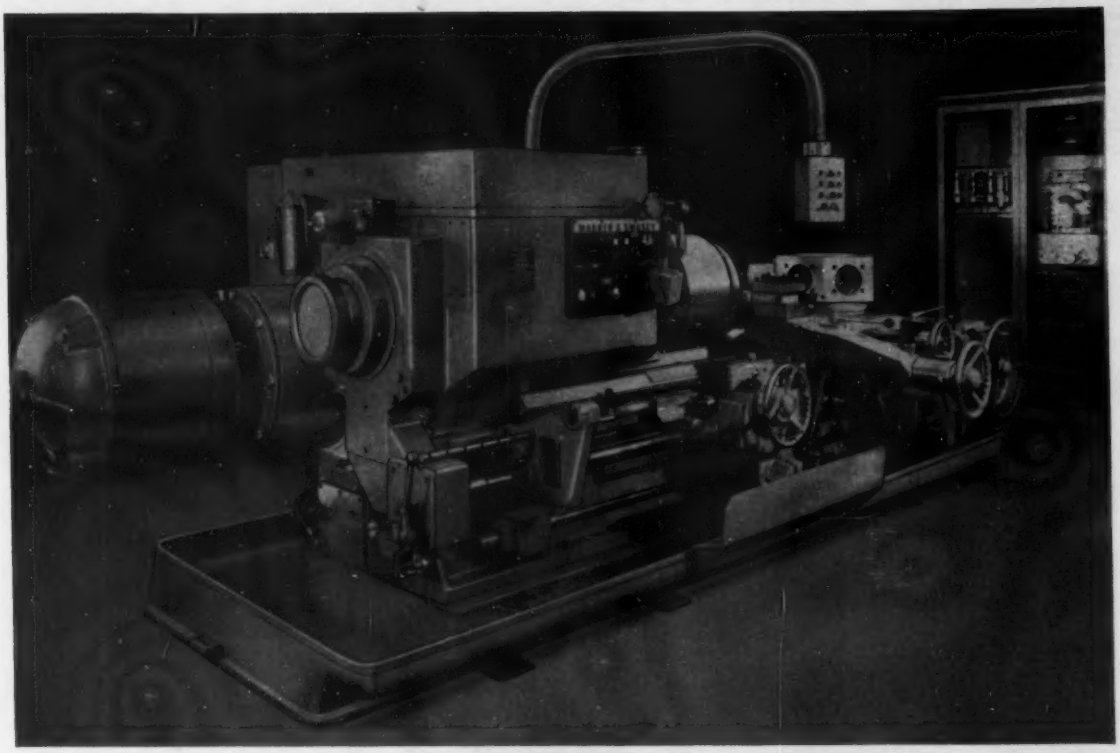


Fig. 2. Servo-Tape turret lathe announced by Warner & Swasey

A two-axis, numerical contour control system, applied in both carriage and saddle aprons of a cross-sliding turret 4-A lathe, as shown in Fig. 2, is also a recent development of the Warner & Swasey Co. Known as the "4-A Servo-Tape" turret lathe, the machine can handle, under tape control, complex contouring work up to the full dimensional capabilities of the lathe. Many problems of tool interference and limited slide travel, often associated with conventional tracer systems, are said to be reduced to a minimum with this new equipment. Because the auxiliary control functions used in contouring are applied by means of standard machine components—through the 4-A lathe's regular feed shaft and full-length leadscrew—the tape system in no way hinders the use of the machine for conventional turret lathe work.

In addition to contouring irregularly shaped surfaces, the numerical contouring system also can be used for straight-line cuts and taper cuts of any angle. Usually the carriage unit is employed for external contouring, while the saddle unit is applied to internal surfaces.

When switching from hand operation to tape control, the operator simply positions the tool-slide unit in the proper location for starting the contour. He then engages the cross-feed and half-nut levers on the apron of the particular slide unit and moves a tape-selector switch to indicate either carriage or saddle, whichever is being used. A touch of the tape "start" switch then initiates the contouring operation, which stops automatically at the conclusion of the cut.

For operator convenience, the tape-selector switch, "start" switch, and related slide-positioning controls are located on an overhead pendant control station projecting from the rear of the lathe. The electronic system used with the 4-A Servo-Tape lathe is digital and incremental in nature, with input of recorded information supplied by standard 1-inch wide Mylar or Mylar aluminum laminate punched tape. A standard Flexowriter with a tape punch attachment is used for tape preparation.

Actuation of the tool-slides during operation is handled by electrical servomotors attached to the regular feed shaft and full-length lead-screw. Operational commands programmed on the tape are fed to the contour control system, from which they are transmitted in the form of varying voltages to the servomotors. The varying voltages control both the direction and speed of servomotor operation.

Geared to each slide's cross-feed screw and to the full-length lead-screw is a device which sends back slide-position data to electronic comparator units in the control system. Slide movement continues until the actual position of the slide corresponds to the required position punched into the tape. At this point slide motion ceases and immediately the control system begins to operate on the next block of information from the tape. This cycle is repeated smoothly and without interruption until the contour is completed.

Either the carriage or saddle unit may be operated under numerical contour control by a simple switch

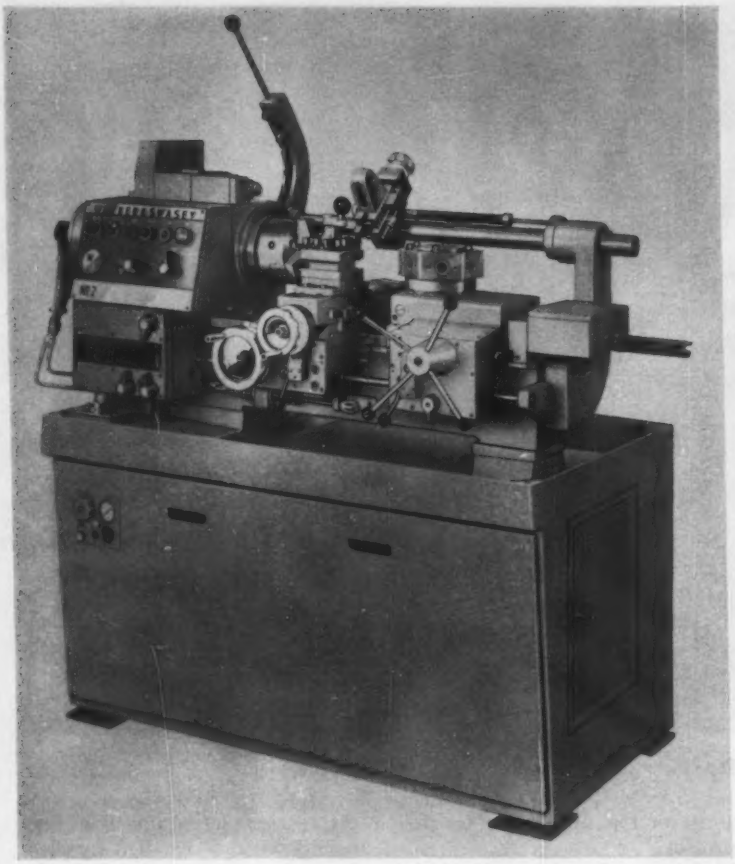


Fig. 3. Warner & Swasey Micro-Cut precision turret lathe

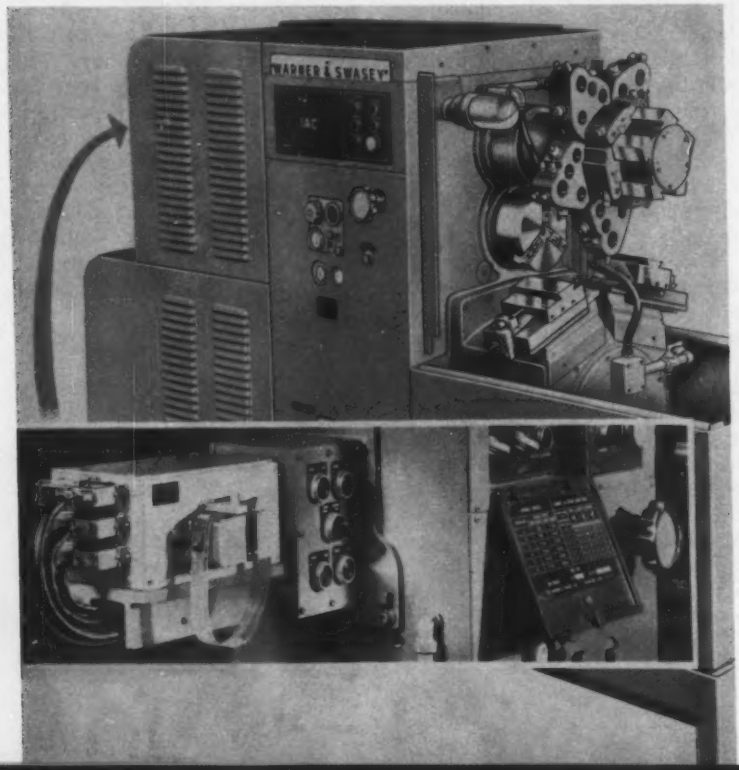
selection. However, these units cannot be operated in this manner simultaneously. Hand positioning of the tool-slides may be accomplished either with the cross and longitudinal handwheels or with the push-button controls located at the pendant control station. The pendant push-buttons are said to actuate the servomotors with a rapid-traverse effect over a travel range equivalent to a fine-to-heavy feed rate.

An all-new ultra-precision turret lathe, known as the "No. 2 Micro-Cut" machine (Fig. 3), is another recent development announced by Warner & Swasey. Specifically designed to handle the most critical machining requirements of medium to small size precision parts, this new lathe is said to be especially suited to optical and instrument work, and many "space age" machining jobs involving miniature electronic, hydraulic, and computer components. In the design of this machine, the over-all ruggedness and universal characteristics of a turret lathe have been combined with the superior accuracy capabilities of a precision instrument lathe. This machine is adapted for production runs on work-pieces that can be chucked only once—because of delicate configuration and critical concentricity limits—yet still demand substantial metal removal and superaccuracy.

The lathe swings 14 inches over the bed and 6 inches over the cross-slide. The spindle is a 5-inch American Standard flanged nose Type A-1. The main drive motor and transmission are pivot-mounted in the base of the lathe, a Poly V-belt drive connecting the transmission with the spindle. The motor is a two-speed, 5- or 2 1/2-hp unit, while the transmission is of three-speed, magnetic clutch design. Three interchangeable transmission output sheaves provide three ranges of six speeds each: 100 to 3000; 70 to 2100; and 50 to 1500 rpm. Spindle control from the operator's panel is handled by two

(Continued on page 174)

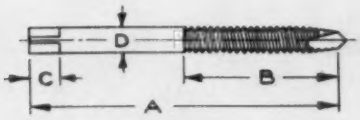
Fig. 4. Numerical tape control system for single-spindle chucking automatic



AMERICAN STANDARD CUT AND GROUND THREAD TAPS—15

Spiral-Pointed Machine Screw Taps

With Short Flutes
High-Speed Steel—Ground Threads



PLUG

General Dimensions

Size	Basic Major Diameter	Threads per Inch			Number of Flutes	Dimensions				
		NC UNC	NF UNF	NS		Length Overall A	Length of Thread B	Length of Square C	Diameter of Shank D	Size of Square E
3	0.099	48	56	..	2	1 13/16	1/2	3/16	0.141	0.110
4	0.112	40	48	36	2	1 7/8	9/16	3/16	0.141	0.110
5	0.125	40	44	..	2	1 15/16	5/8	3/16	0.141	0.110
6	0.138	32	40	..	2	2	11/16	3/16	0.141	0.110
8	0.164	32	36	..	2	2 1/8	3/4	1/4	0.168	0.131
10	0.190	24	32	..	2	2 3/8	7/8	1/4	0.194	0.152
12	0.216	24	28	..	2	2 3/8	15/16	9/32	0.220	0.165

All dimensions are given in inches.

These taps are furnished in plug style and only in the following limits:
No. 3 to 5 NC and NF inclusive and No. 4 NS in H2 limit
No. 6 and 8 NF in H2 limit
No. 6 and 8 NC in H3 limit
No. 10 and 12 NC and NF in H3 limit

Short flute spiral pointed machine screw taps are provided with the spiral point only. The balance of the threaded section is left unfluted.

All taps have external center on thread end.

Tolerances*

Element		Range	Direction	Tolerance
Length Overall	(A)	3 to 12 incl.	plus or minus	1/32
Length of Thread	(B)	3 to 12 incl.	plus or minus	3/64
Length of Square	(C)	3 to 12 incl.	plus or minus	1/32
Diameter of Shank	(D)	3 to 12 incl.	minus	0.0015
Size of Square	(E)	3 to 12 incl.	minus	0.004

All dimensions are given in inches.

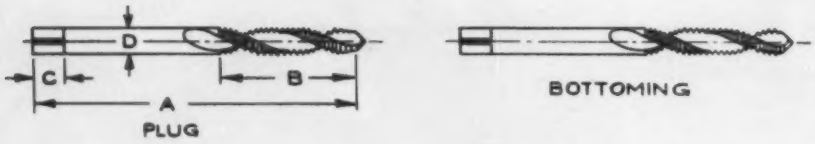
*For eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet published in February, 1960, page 186.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—16

Helical (Spiral) Fluted Machine Screw Taps

High-Speed Steel—Ground Thread



General Dimensions

Size	Basic Major Diameter	Threads per Inch		Number of Flutes	Dimensions				
		NC UNC	NF UNF		Length Overall A	Length of Thread B	Length of Square C	Diameter of Shank D	Size of Square E
3	0.099	48	56	2	1 13/16	1/2	3/16	0.141	0.110
4	0.112	40	48	2	1 7/8	9/32	3/16	0.141	0.110
5	0.125	40	44	2	1 15/16	5/8	3/16	0.141	0.110
6	0.138	32	40	2	2	11/16	3/16	0.141	0.110
8	0.164	32	36	2	2 1/8	3/4	1/4	0.168	0.131
10	0.190	24	32	2	2 3/8	7/8	1/4	0.194	0.152
12	0.216	24	28	2	2 3/8	15/16	9/32	0.220	0.165

All dimensions are given in inches.

These taps are furnished in plug or bottoming style and only in the following limits:
No. 3 to 5 NC and NF inclusive in H2 limit
No. 6 and 8 NF in H2 limit
No. 6 and 8 NC in H3 limit
No. 10 and 12 NC and NF in H3 limit

Helical fluted taps have a right hand spiral flute with a Helix angle of from 25 to 35 degrees.

All taps have external center on thread end.

Tolerances*

Element		Range	Direction	Tolerance
Length Overall	(A)	3 to 12 incl.	plus or minus	1/32
Length of Thread	(B)	3 to 12 incl.	plus or minus	3/64
Length of Square	(C)	3 to 12 incl.	plus or minus	1/32
Diameter of Shank	(D)	3 to 12 incl.	minus	0.0015
Size of Square	(E)	3 to 12 incl.	minus	0.004

All dimensions are given in inches.

*For eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet published in February, 1960, page 186.

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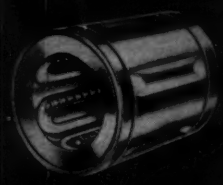

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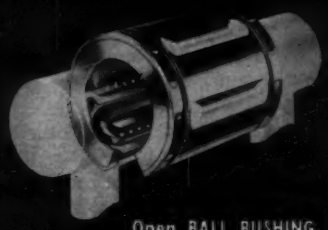

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LINEAR MOTIONS

Sliding linear motions are nearly always troublesome. Thousands of progressive engineers and designers have solved this problem by application of BALL BUSHINGS on *guide rods, reciprocating shafts, push-pull actions,* or for support of *any mechanism that is moved or shifted in a straight line.*

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PROGRESSIVE MANUFACTURERS USE BALL BUSHINGS–A MAJOR IMPROVEMENT AT A MINOR COST

lever-operated switches. One has six positions for speed selection; the other controls forward, brake, and reverse. Speed changing is instantaneous. Braking is accomplished both electrically and hydraulically by plugging the motor and engaging two clutches for holding. A shaft-driven, reversing, lubricating oil pump employed on this machine is integral with the transmission.

In order to cover the widest possible range of job applications, the No. 2 Micro-Cut lathe is being made available in three different model configurations, as follows: (1) Plain turret lathe equipped with a plain cross-slide with hand longitudinal adjustment and a conventional hexagon turret. This model can be furnished with collet chuck, bar feed, and related equipment. (2) Universal turret lathe, Fig. 3, which is basically similar to the plain turret lathe design but features a full universal cross-slide and square turret. (3) Precision chucking turret lathe which features a flat type eight-station cross-sliding turret exclusively.

Single-point over-arm threading, air-operated collet chuck, and bar feed equipment with up to 1 1/4-inch capacity, and several arrangements of 6-inch two- and three-jaw hand or air chucks are available for all three machines. Electro-Cycle equipment is optionally available for hexagon turret units.

For those shops interested in the use of tape controls, the Warner & Swasey Co. has announced the development of an optional numerical tape control system (see Fig. 4) for its 1AC single-spindle chucking automatic. The new and relatively simple tape system is capable of controlling all 1AC operating functions, including speed and feed changing, cross-slide movements, and lengths of cut. Only high-low speed range selection and installation of the proper feed gears need be handled separately by the operator during set-up. Aside from this, the entire automatic machining cycle which the system controls can be preplanned on the tape.

When equipped as a tape-controlled machine, the 1AC is "convertible," so that the operator can switch from tape programming to the standard electromechanical control system. The optional tape system provides many of the previously available special machine functions for the 1AC without the installation of additional electrical equipment. Drill relieving, for example, is provided without a separate attachment.

Standard 1-inch wide, eight-channel paper or plastic tape can be used with the new control system. All tape-handling and control equipment is contained in compact units on the machine. Control operation involves a pure electrical relay system, using well-known telephone type relays for compactness and reliability. There is no electronic circuitry in the design. The tape reader and encoder device of the system are products of Wang Laboratories, Inc.

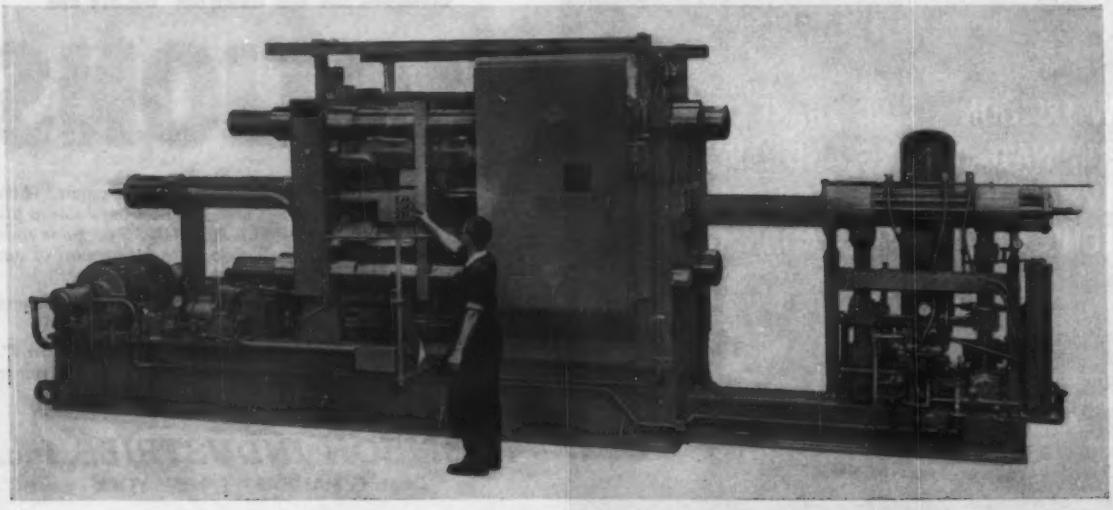
Circle 567 on Readers' Service Card

Huge Cold-Chamber Die-Casting Machine

A 1000-ton die-casting machine, built by the B & T Die Casting Machinery Division of Greenlee Bros. & Co., Rockford, Ill., checks out at 1200 tons lock-up pressure on the strain-gage test. This huge machine weighs 85,000 pounds; is 8 1/2 feet wide by 26 feet long and 10 feet high. Its four-corner linkage provides full support for the die, resulting in exceptional platen stability. Platens are 5 feet high, 5 feet wide, and 1 foot thick. Each of the four tie-bars measures 8 inches in diameter.

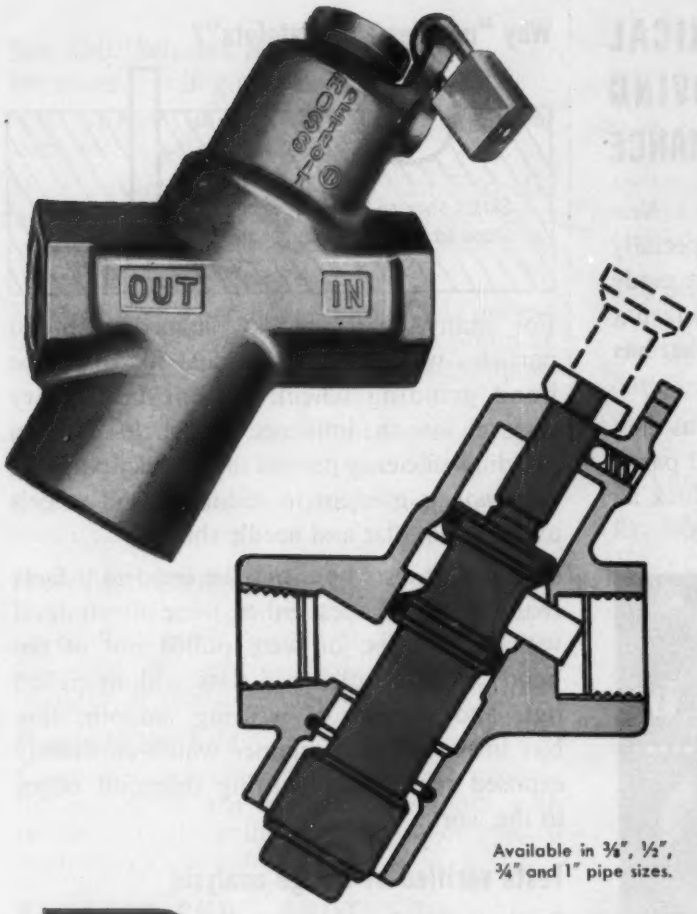
The machine, designed for die-casting aluminum, is of the cold-chamber, high-pressure injection type. Hydraulic and electrical safety features assure dual control in all areas. This first 1000-ton machine is built especially for use in the production of large aluminum die castings for the automotive and similar fields.

Circle 568 on Readers' Service Card

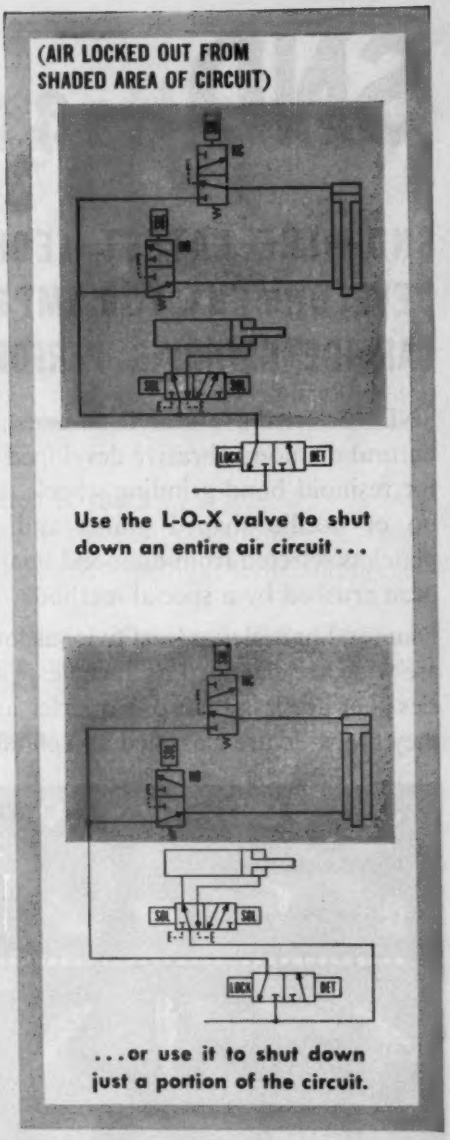


Die-casting machine built by B & T Die Casting Machinery Division of Greenlee Bros. & Co.

Lock out air for machine repair



Available in ⅜", ½", ¾" and 1" pipe sizes.


(AIR LOCKED OUT FROM SHADED AREA OF CIRCUIT)
Use the L-O-X valve to shut down an entire air circuit...
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Now you can actually lock out air that operates a machine, as a safeguard when making machine repairs. The Ross L-O-X Valve installs in the supply line leading to the machine, upstream of any operating valve. It is so designed that when closed, supply-air to the machine is shut off and air downstream is exhausted. The valve can be *padlocked* in this position.

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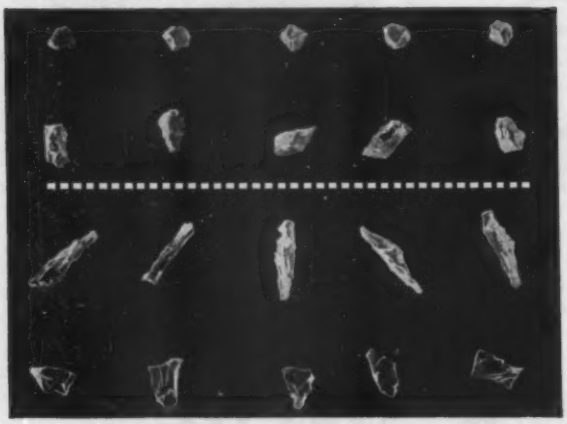
SND — a new natural diamond

SND—THE LATEST TECHNICAL DEVELOPMENT FOR IMPROVING CARBIDE GRINDING PERFORMANCE

SND (Selected Natural Diamonds) is a *New* natural diamond abrasive developed especially for resinoid bond grinding wheels. It is made up of needle shaped grains and thin, flat platelets selected from diamond boart that has been crushed by a special method.

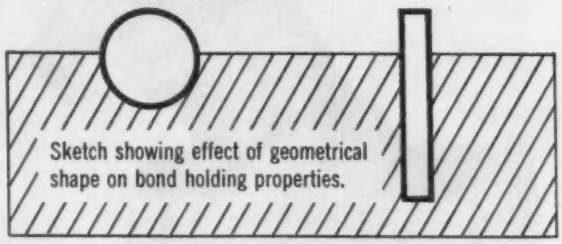
Diamond particles at least twice as long as they are wide are classified as "needles," and particles that are less than one-quarter as thick as they are wide are classified as "platelets."



Top: Blocky diamond particles predominating in conventional grit.

Bottom: Needle and platelet diamond particles predominating in new SND Selected Natural Diamond grit.

Why "needles and platelets"?



Sketch showing effect of geometrical shape on bond holding properties.

For many years, blocky shaped diamond particles were considered ideal for any type bond grinding wheel. Recent laboratory research into the influence of particle shape on grinding efficiency proved that blocky particles were *not* as efficient in resinoid bond wheels as were thin, flat and needle shapes.

Subsequent tests bore out the important facts that, blocky shapes either wore down level with the matrix, or were pulled out of the bond; while needles and flats seldom pulled out, and instead of wearing smooth, tiny bits broke off in a manner which constantly exposed new, sharp cutting diamond edges to the work.

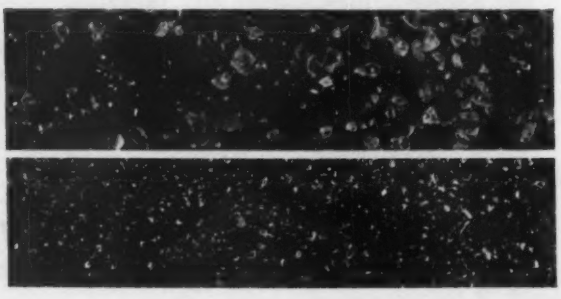
Tests verified by sludge analysis

Analysis of the sludge and swarf collected after tests of both SND and conventional grit wheels verified the test findings. Only uniformly tiny diamond particles were found in residue from SND wheels, proving that each SND particle was almost wholly utilized in the grinding process.

Conventional natural diamond grit sludge ▶

The absence of large particles in SND—Selected Natural Diamonds sludge shows *why* SND gives up to 30% longer wheel life and increased wheel efficiency over conventional diamonds.

SND-Selected Natural Diamond grit sludge ▶



grit for higher grinding efficiency!

How SND (Selected Natural Diamonds) increases grinding efficiency

SND provides more sharp cutting edges per carat in the same grit size.

More cutting edges means a faster, cooler cutting wheel that will last up to one-third longer than resinoid wheels made with conventional grit.

The thin needle and flat grains in SND possess the right amount of natural strength, yet break down easily for fast, free, and continuous cutting.

SND grit offers maximum holding surfaces to the bond, reducing non-productive pull-outs.

SND sharper cutting edges reduce wheel loading and glazing.

Proved in laboratory runs . . .

Extensive laboratory runs show SND grit is up to 30% more efficient than conventional grit when grinding cemented carbide at .0005" to .0015" in-feeds and speeds of 5500 S.F.M.

Proved in the field

Many metalworking plants now are proving the new SND grit in their own shops with results that substantiate the already-completed laboratory evaluations.

TREATED SND—ANOTHER NEW GRIT DEVELOPMENT!

A process for treating SND (Selected Natural Diamonds) grit to make it even more friable and to give it superior bonding properties in resinoid wheels also has been developed. This process introduces surface irregularities in the otherwise smooth planes of the SND particles; these tiny cracks and crevices promote faster breakdown after wear and stronger bonding. Already proved to be more efficient than conventional grit at feeds of .0005" to .0015", on carbide, Treated SND is recommended only for lighter feeds, and where the nature of the work demands rapid grit particle breakdown.

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Conventional grit—for heavy feeds (.003" and up) and the recommended material for metal or vitrified bond wheels.

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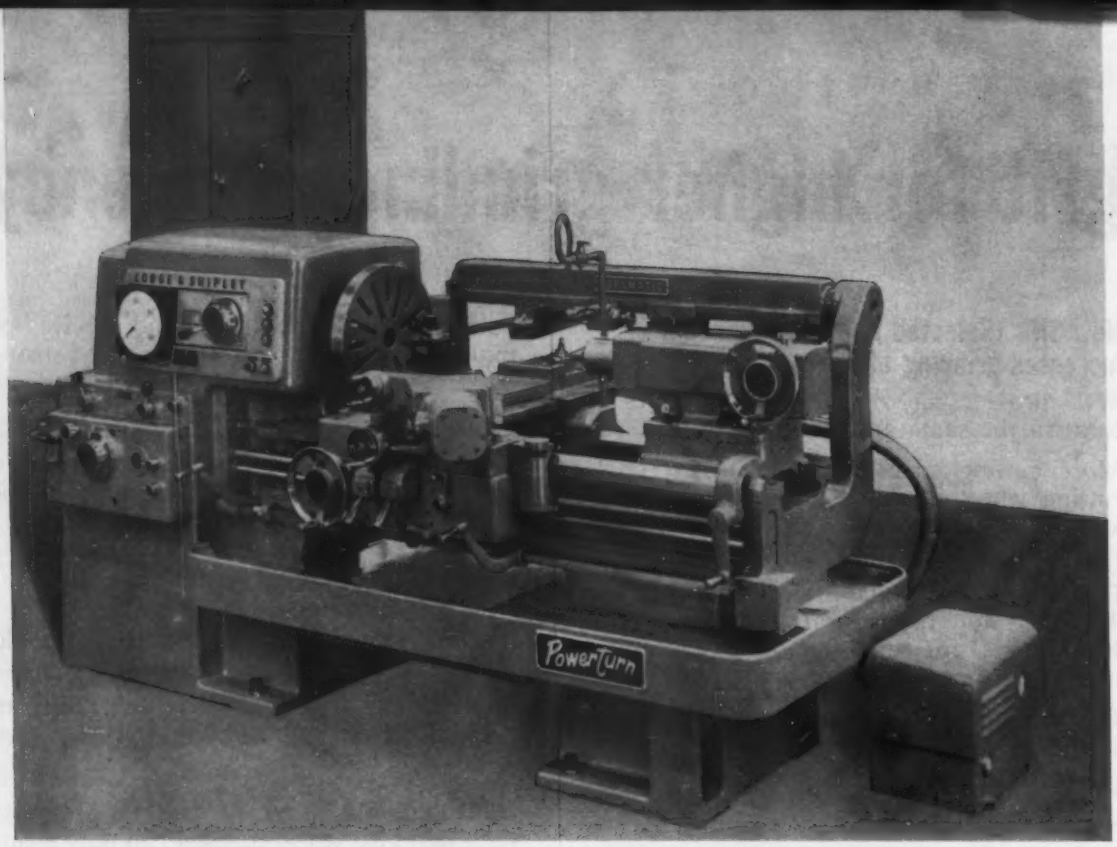


Fig. 1. Lodge & Shipley Powerturn 45-degree Copymatic constant-cutting-speed lathe

Powerturn Copymatic Constant-Cutting-Speed Lathe

A universal constant-cutting-speed lathe that eliminates the need for speed-control cams and computations has been announced by the Lodge & Shipley Co., Cincinnati, Ohio. This lathe is built in Powerturn 45-degree Copymatic models in sizes from 2013 to 3220-37 and provides constant cutting speed at any point, regardless of contours. Besides giving greater accuracy and smoother finish, this unit is said to eliminate the cost and delay of providing a special speed-control cam for each job.

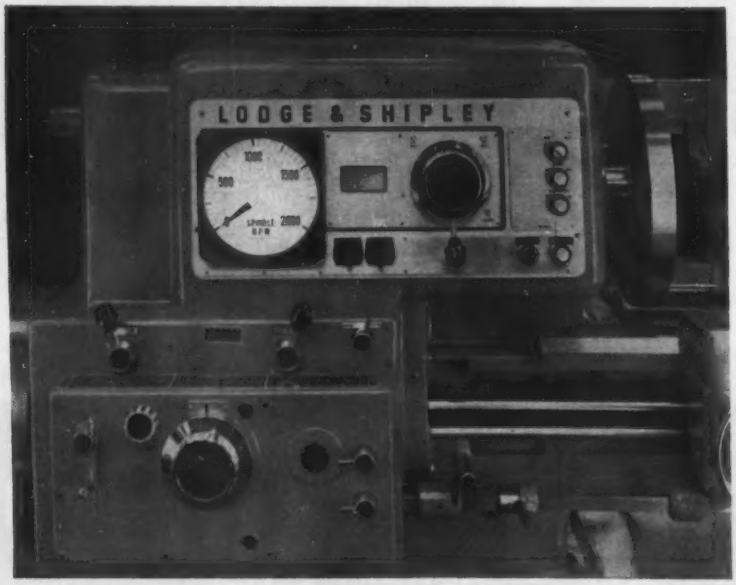


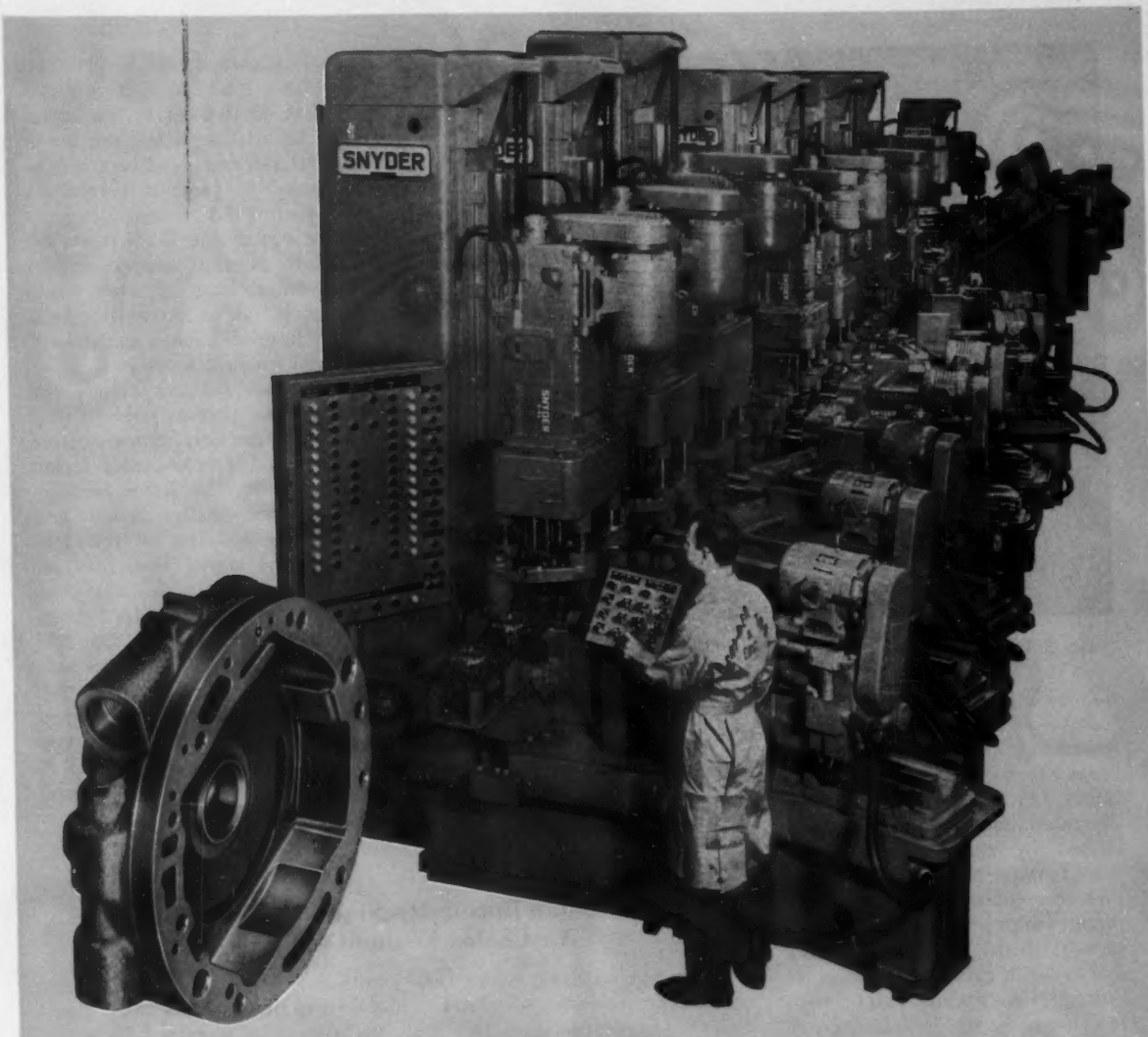
Fig. 2. Close-up of constant-cutting-speed control of lathe shown in Fig. 1

The 2013 size Powerturn 45-degree Copymatic model, Fig. 1, has a capacity of 30 inches between centers. The unit at the right end of lathe is the Copymatic hydraulic system reservoir, filter, pump, and motor unit. Behind the left end of the lathe is the cabinet with variable-speed control for the direct-current drive-motor. This lathe slide extension for cross-center also is equipped with special cross-facing and automatic-reversing controls for spindle and feed.

The constant-cutting-speed lathe control, Fig. 2, is equipped with special three-speed mechanical-shift headstock and a 20 to 1 ratio variable-speed drive. The three mechanical-shift speed ranges are: 4.7 to 93, 21.6 to 431, and 100 to 2000 rpm. Manual and automatic speed-control selector and potentiometers control speeds in either direction. The large tachometer shows the spindle speed.

This equipment, with an opera-

(Continued on page 180)



SNYDER BUILDING-BLOCK PRINCIPLE MAKES TRANSFER MACHINES VERSATILE, CONVERTIBLE, THRIFTY

Transfer machines built up on the "building-block" principle are old stuff at Snyder and we've built all kinds of them—including the ones that turn corners and bring the part back to where it started from, processed from half-a-dozen angles, gaged, probed, automatically inspected in process, washed and dried and rejects marked for re-processing. Nothing to it if that's what the job calls for. We call it the Snyder Building-block Principle.

Here's an example of a fairly simple Snyder building-block transfer. This 58 station machine performs 74 operations on an automatic transmission pump body, drilling, reaming, tapping, gaging and probing 180 parts an hour at 100% efficiency. Any or all of its 22 segments can easily be converted to perform comparable operations on other parts. Also, the number of segments can be reduced or increased at any time, as need dictates. Your inquiries are invited.

SNYDER
CORPORATION
(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

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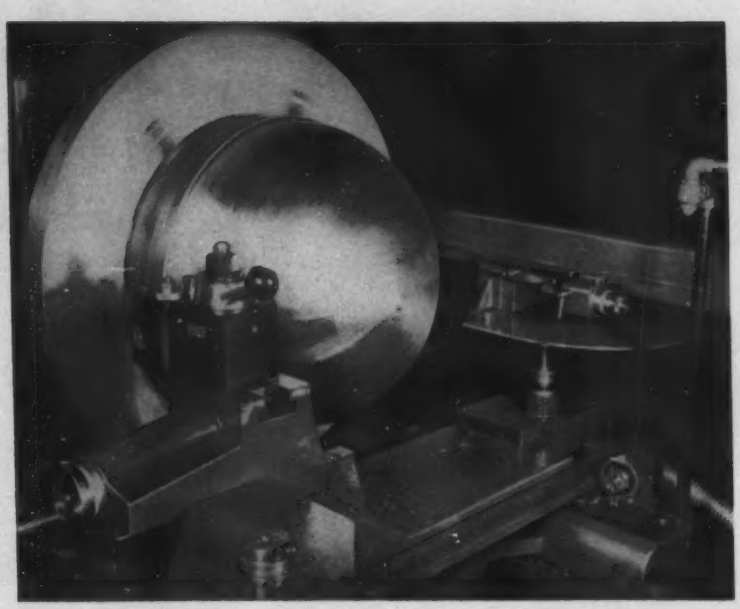


Fig. 3. Turning a 26-inch-diameter hemisphere on a 3220-32 Powerturn lathe

tion technique the company calls "combined feeds," makes possible machining capacities substantially greater than on conventional tracer lathes. As a typical example, a 26-inch-diameter hemisphere, machined by conventional tracing, would require an 18 1/2-inch-diameter cylinder stroke which is plainly impractical and unnecessary. With the setup, Fig. 3, only a 9 1/2-inch cylinder stroke is required. Longitudinal and cross-feed are engaged simultaneously to give a straight tool path in a line which might be termed a "mean" of the contour. Then, the hydraulic cylinder needs to provide only for the difference between this path and the contour being machined.

It is pointed out that conventional cross-feed and longitudinal feed (in a 1 to 1 ratio) give a tool path at 45 degrees to the center line. In extreme cases, the longitudinal and cross-feed ratio can be increased to provide a resultant tool path at 10 or even 5 degrees to the center line. Such ratios are ideal for venturi shapes, nozzles and other long, slender work-pieces in which there is a relatively large difference in the largest and smallest sections.

Other new features include end gearing that permits reduced feed rates for extremely critical surface finishes and a cross-center facing arrangement. The latter arrangement automatically brakes and stops the spindle as the tool reaches the center line, then reverses and restarts spindle rotation. At the same time, feed direction is reversed and the tool continues feeding to the back side of center, all under tracer control. A special swivel arrangement permits mounting of an integral type spindle for contour grinding. A modification of this device is used for electrolytic grinding.

Circle 569 on Readers' Service Card

Precision Boring Machine for Processing Air-Cooled Engine Crankcases

A two-way precision boring machine built recently by the Ex-Cell-O Corporation, of Detroit, Mich., performs one of the most critical machining operations required in the production of a four-cycle gasoline engine. The work consists of precision boring of crankshaft and camshaft bearing holes. Two work-pieces are involved: one right-hand, one left. The Ex-Cell-O-designed fixture accommodates both aluminum-alloy components interchangeably. Change-over from one batch to another involves only a change of boring quills.

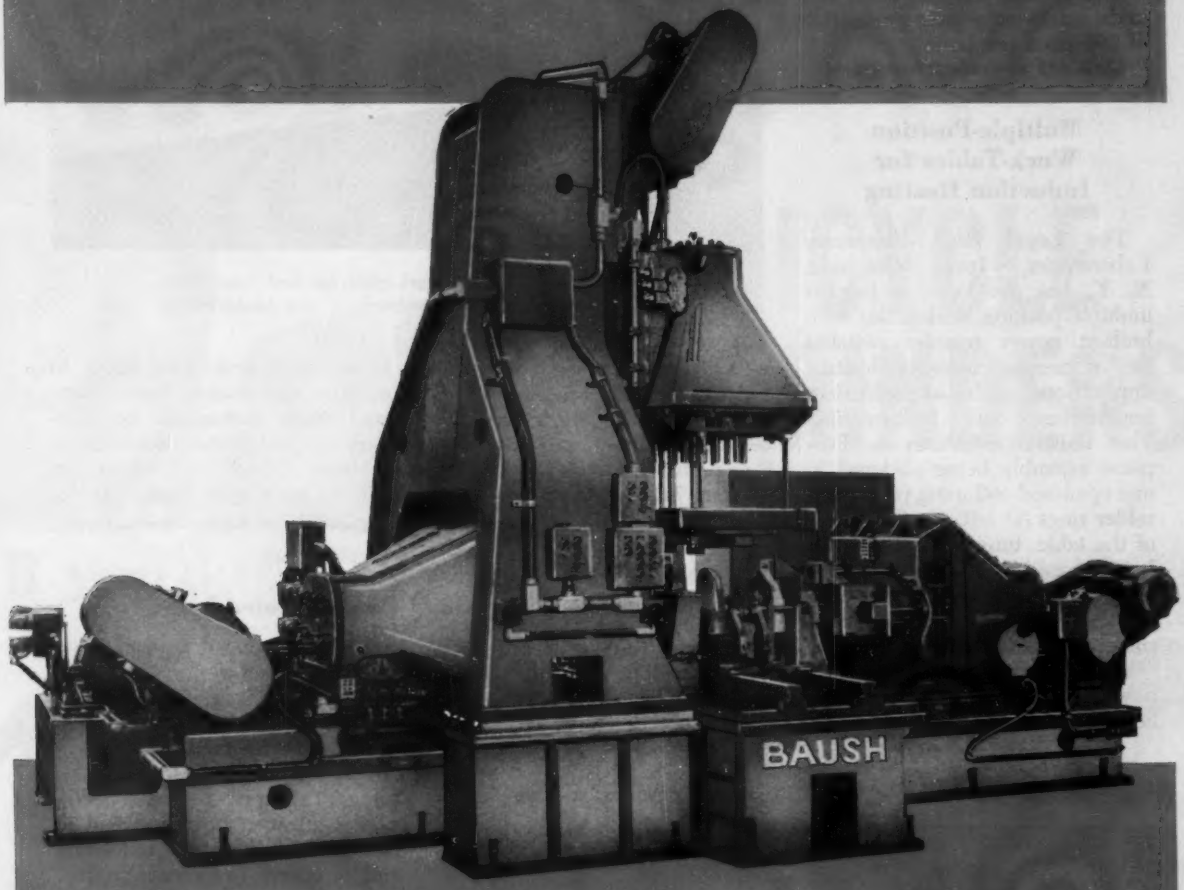
Ex-Cell-O precision boring machine equipped to process engine crankcases

In operation, the work-pieces are manually loaded. Location is taken from two previously bored dowel holes. Clamps are swung into the closed position and locked hydraulically. The left slide then rapid traverses into the working position and precision boring of the camshaft hole is performed in addition to facing the boss and chamfering. Tolerance on hole diameter is held within 0.0005 inch.

The crankshaft bearing diameter is precision bored by spindles

SPECIAL 3-WAY "H-15" AUTOMATIC HYDRAULIC

WITH MULTI-SPINDLES FOR DRILLING AND REAMING TRACTOR PARTS



Baush specifically designed this single purpose machine to speed production for a leading tractor manufacturer. This "H-15" is unique in that by changing the hydraulic unit to a recirculating ball screw the machine becomes a 100% mechanical leadscrew machine.

Three 20" x 30" heads are bored and furnished with 24 spindle pinions, and all spindles are arranged for two (2) speeds and a neutral position. The heads have master-bored cluster plates with a total of 35 slip-sleeve spindles for drilling or reaming.

As illustrated, this machine has automatic hydraulic operation of fixture and slide.

Electrical controls are all J. I. C. Standard, with three (3) of the motors being 15 HP and three (3) 5 HP.

Write for new brochure with complete specifications.

Sections, or all of this type machine are adaptable to working different parts in the future with a minimum of changeover.

BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS

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mounted on the right slide. Here, the work is also counterbored and chamfered. Tolerance of hole diameter is held within 0.0003 inch. This cycle of precision operations, including load and unload, is made in a total of only twenty-seven seconds, achieving a gross production of 266 parts per hour.

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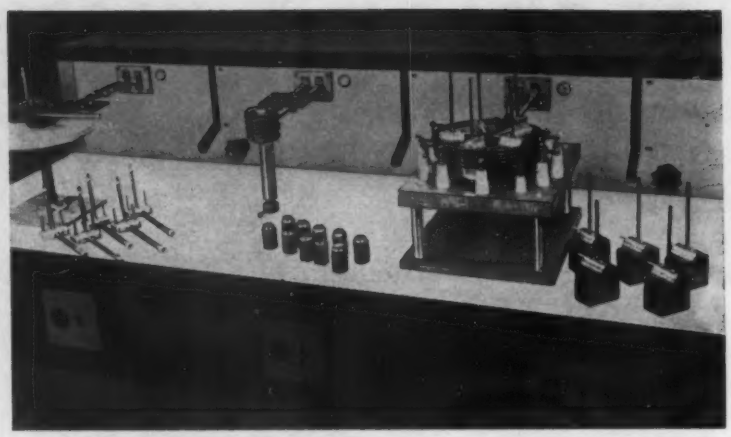


Lepel multiple-position work-table for such operations as soldering, brazing, bombarding, and heat-treating

Multiple-Position Work-Tables for Induction Heating

The Lepel High Frequency Laboratories, Inc., Woodside, N. Y., has developed a line of multiple-position work-tables with built-in power transfer switches for numerous induction-heating applications such as soldering, bombarding, and heat-treating. The illustration shows a five-piece assembly being soldered in one open-end coil using preformed solder rings (at left); in the center of the table, tungsten contacts are being brazed to brass bodies using silver solder; on the right, five copper and brass assemblies are being soldered within one heating coil.

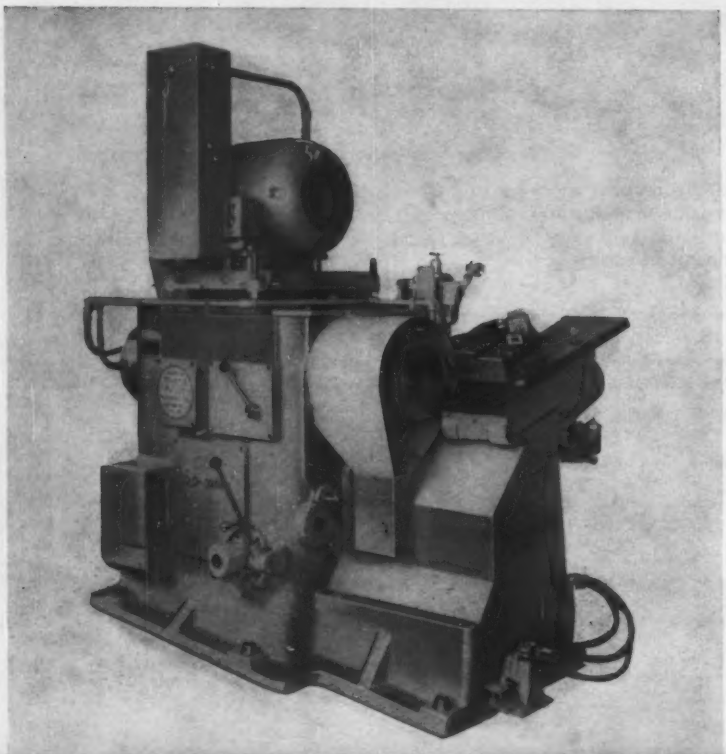
The three-position work-table is powered by a single induction-heating generator, which can be switched from one working station to another. The advantage of leaving the operating setup as is, proceeding to the next application, then returning to the original setup without loss of time, is an outstanding feature. The work-table is equipped with pilot lights to indicate the station being powered. Each station can be operated by push-button, foot-switch, or timer. These work-tables can also be built with quench tanks.

Circle 571 on Readers' Service Card

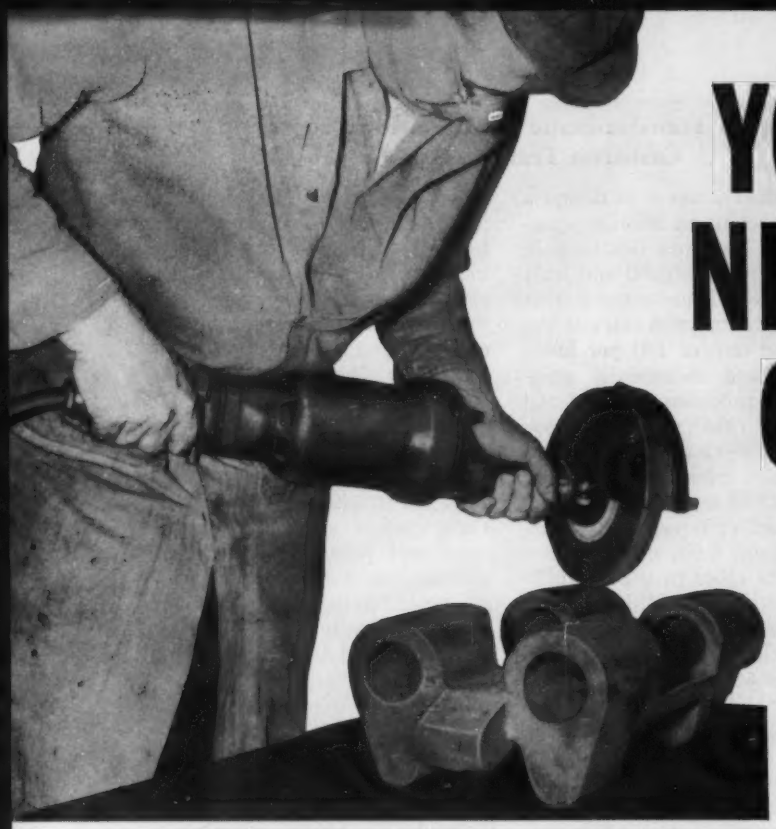
Automatic "Lo-Swing" Cam-Operated Lathe

A Model "AR" automatic "Lo-Swing" cam-operated lathe of special design has been announced by the Seneca Falls Machine Co., Seneca Falls, N. Y. The unit has been developed to provide a powerful, rigid machine capable of taking heavy cuts with coarse feeds of 0.080 ipr for facing 10-inch-diameter by 1-inch-thick pipe couplings. This application also necessitated an open front and end to facilitate loading and unloading and, of course, to increase production.

Seneca Falls specially designed "Lo-Swing" cam-operated lathe



The machine consists of a Model AR lathe headstock and a short bed section mounted on a specially designed inclined base. The 8-degree incline of the base tilted the machine and chuck sufficiently to prevent the work-piece from falling out of the chuck when the jaws were open for loading or unloading. This feature was particularly important to operator safety since it eliminated the hazard of a falling work-piece caused by the heavy, awkward design of the pieces. Also, the operator was no longer required to hold the work-piece upright in the chuck while closing the chuck jaws, thus eliminating any possibility of pinching a finger or a hand. Other important design features are the machine's



YOU NEED CP HICYCLE GRINDERS

If you do "heavy duty" production grinding

CP-550-SAG with stationary guard for rotary cup.

CP-550-SAG with revolving cup guard.

CP-550-SAS with angle sander.

CP-SAG with guard for 9" cut-off wheel or depressed center disc wheel.

CP-550-SAP with polisher.

And here are 8 reasons why...

1. Hicycle motor of advanced squirrel-cage design runs on 180 cycles, 220 volts, 3-phase current. No brushes to replace . . . No armature to burn out. **2. Speed sag** is less than 15% under load, for maximum output. **3. "Tri-Flo" cooling system** minimizes "hot spots". Keeps temperature rise at key points as much as 28° lower than with conventional type cooling. Prevents burnouts. **4. Built-in overspeed protection. 5. Power/Weight Ratio** is outstanding because high strength magnesium castings are used for motor, gear case, and switch handle. **6. Extra heavy micro-mesh gearing** heat-treated for long service. Oil-sealed ball bearings lubricated for life. **7. Interchangeable motors,** motor housings, switch handles, and switches between all straight and angle models. **8. Heavy duty switches** have dust-tight seals and phenolic spacers for insulation and to minimize vibration.

Heavy duty 6" and 8" Hicycle Grinders are available in straight and angle models. For complete information, write to: *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

Chicago Pneumatic

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open work area and foot-operated air chuck which permit ease of loading and unloading as well as reduction of operator fatigue.

A back carriage utilizing a back squaring attachment and two carbide cutting tools are part of its equipment. The tools are automatically fed to a preset position for depth of cut. Then the automatic back-squaring attachment moves the tools through the cutting cycle across the face of the work-piece. Two separate cutting operations are accomplished simultaneously in this application. When the cutting cycle is complete, the machine's rapid-traverse mechanism returns the tools to the starting position, thus completing the automatic cycle.

As an added safety feature, the pneumatic spindle clutch-operating valve is fitted with a time-delay mechanism that prevents spindle starting until the chuck jaws are securely closed. This completely eliminates any possibility of a work-piece being thrown from the chuck by starting the machine before the work-piece is secured.

Circle 572 on Readers' Service Card

Cross Transfer-matic for Precision Processing Cast-Iron Transmission Cases

It is rather unusual to design a transfer machine for finishing operations, but The Cross Co., Detroit, Mich., has just designed and built a five-station Transfer-matic that processes transmission cases at the production rate of 140 per hour. This machine successfully combines high-precision finishing operations with the production economy of automation. It holds some bore sizes to tolerances of plus or minus 0.00035 inch, and the location of each of three holes within plus or minus 0.001 inch with respect to the other two. Twin milling operations establish over-all part length within plus or minus 0.0039 inch. Surface-finish specifications are 56 to 110 micro-inches for all machining operations.

Every detail of the machine, Fig. 1, has been developed to assure accuracy in processing the cast-iron transmission case, Fig. 2, which is used in a small European automobile. The work-pieces are delivered to the Transfer-matic in the rough-machined condition. It may be noted that the design of these transmission cases was no help in adapting a transfer type machine to their production. Locating holes are in lugs on top of the work-piece as far from the clamping points as it is possible to have them. The lugs for the locating holes are removed from the finished part before it is used.

Work-pieces (Fig. 2) are clamped, two at a time, with the cover faces down, in precision pallet fixtures. These pallets are accurately located and positively clamped in successive machining stations. They are located in the horizontal plane at each station by six buttons. Air is blown over these buttons during each transfer to prevent chips from lodging on them.

Pallets are located both longitudinally and transversely by a wedge-and-slot device after they have been approximately positioned by the lift-and-carry transfer bar. The precise location is achieved by a wedge which is pushed into a slot in the pallet by

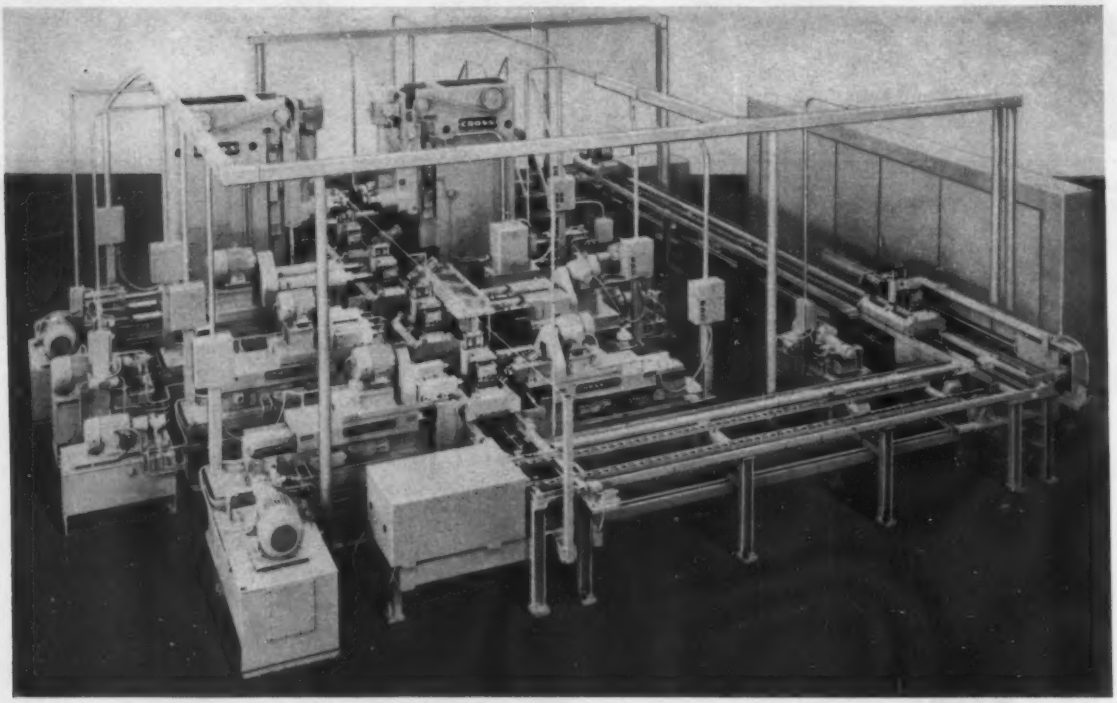

Fig. 1. Cross Transfer-matic that holds extremely close boring tolerances while maintaining a production rate of 140 transmission cases per hour

As this heavy-duty milling machine makes a high-speed cut, vital components of AISI 4340 and 4620 nickel alloy steels provide strength and wear-resistance, help maintain precision tolerances.

Two nickel alloy steels...4340 and 4620... give this machine sustained cutting accuracy

Here's how two general-purpose steels used by Kearney & Trecker in their heavy duty TF series milling machine have helped that company maintain its famous high-performance standards:

The spindle is made of AISI 4340 nickel alloy steel. This through-hardening steel is quenched and tempered to develop good fatigue strength and high tensile strength with a minimum of distortion. Spindles of 4340 steel resist torsional stresses and wear while maintaining straightness at every running speed.

Gears are precision-cut and wide-faced. They are made of AISI 4620 general-purpose carburizing steel. These gears are carburized and hardened to 58-62 Rockwell "C". What's more, AISI 4620 nickel alloy steel has a tough core to withstand shock loading.

This report is typical of the many coming in from manufacturers who have employed the two General Purpose Steels for a variety of machinery components.

Available right off the shelf from your local Steel Service Center, AISI 4340 and 4620 offer you a two-fisted way to cut costs and still satisfy the majority of your engineering requirements. Other standard nickel-containing steels – providing particular combinations of properties – are also available from your Steel Service Center for your remaining needs.

Consider nickel alloy steels for gears, shafts, bearings and other machine parts you design, order or use. And any time you require engineering information to help you select the right material for your application, write to INCO, outlining your problem. We will be glad to help.

The INTERNATIONAL NICKEL COMPANY, Inc.
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means of a hydraulic cylinder. The reference plane for all longitudinal dimensions is the flat side of the slot in each of the pallets. As the wedge moves the pallet into its longitudinal position, it also pushes the pallet transversely against two stop buttons. These buttons are set with their faces 30 degrees from the vertical, matching locating surfaces on the pallet, which causes it to be wedged downward. It is the combination of these forces that clamps the pallet.

Passages, carrying low-pressure compressed air, lead to orifices in both the straight and the inclined faces of the wedge and the locating faces of the two transverse stop buttons. All of these orifices are open to the atmosphere until the pallet is accurately located and correctly clamped. Then, pressure build-up in the air lines activates an air-operated limit switch and initiates the machining cycle.

High-accuracy location of the pallets is necessary because not all holes whose locations are tied together by close tolerances could be bored with clustered spindles in one station. Because of their proximity on the work-piece, each of the three holes tied together by the tightest location tolerances is finished in a different station. Each of the eight Cross precision-boring spindles is separately mounted on its slide so that each can be adjusted individually.

The boring-bars are designed to dampen vibrations. Those for the largest holes, Fig. 3, finish both end holes from the same side of the machine. One of these holes is made larger than the other so that the boring-bar can pass through. Each of the boring-bars for these holes has four micro-adjustable boring cartridges, one for semi-finish and one for finish cuts on each hole. Boring-bars for the smaller holes have the same construction and the same individual adjustment for each cutting bit. Two holes are finished with a single straight-fluted reamer.

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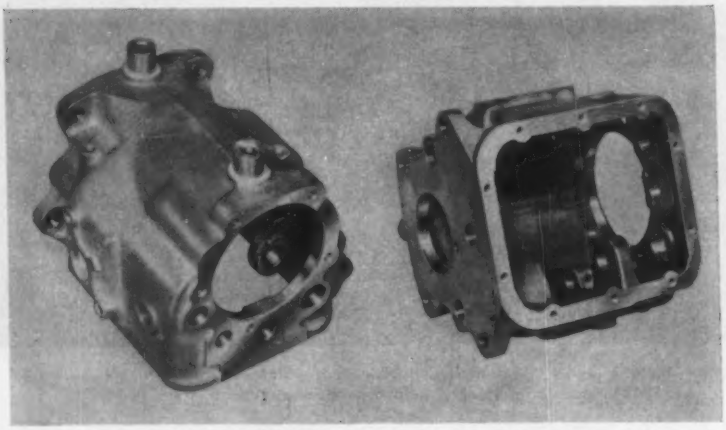

Fig. 2. Work-pieces located in pallet fixture, Fig. 3, have both end faces milled, and all the major holes in both ends finished on Cross Transfer-matic

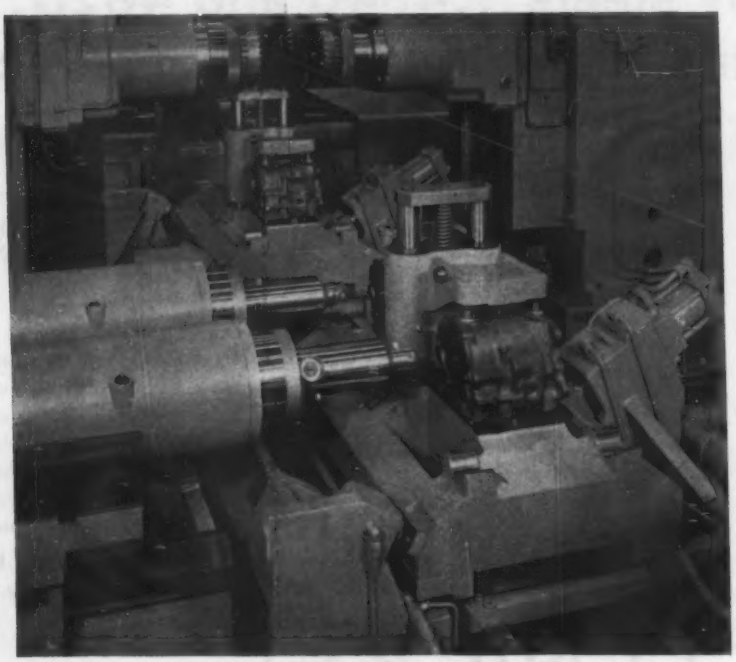

Fig. 3. Pallet-fixture location is the key to the close accuracy maintained in boring operations on Transfer-matic, Fig. 1

Sheffield Master Setting Rings and Discs

Class XXXX master setting rings and discs manufactured to tolerances as fine as five millionths of an inch are available from the Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation. These new products are made in both A.G.D. and Sheffield Precisionaire master ring and disc styles. They are used to calibrate high-amplification Precisionaire air gages and various other types of precision measurement instruments.

Class XXXX rings and discs within the size range of from 0.125 to 0.825 inch are calibrated and certified to an accuracy of 0.0000025 inch by the company's Eli Whitney Metrology Laboratory, while sizes 0.825 to 1.000 inch are calibrated and certified to an accuracy of 0.0000035 inch. The rings are also inspected for circularity, taper, and bellmouth. Dimensional size as well as deviation from circularity are recorded on the certificate of inspection accompanying each ring. Other sizes can be supplied on special order.

Circle 574 on Readers' Service Card

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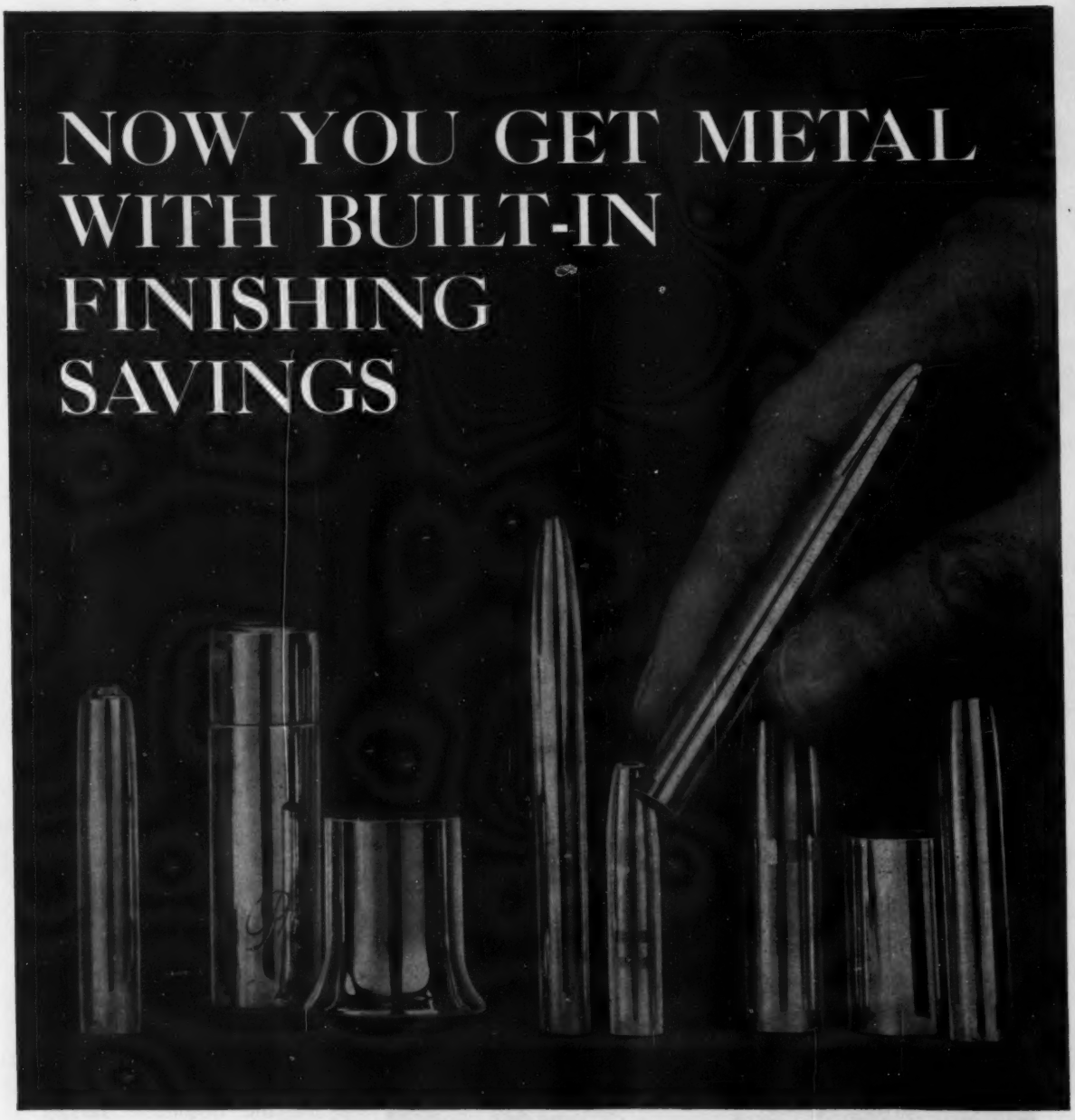


Faster production and up to 40% cut in polishing costs are made possible by superfine-grain structure of Formbrite® Drawing Brass

The jeweler's finish which Accurate Forming Corp., Franklin, N. J., gives pen caps and barrels previously meant the use of five polishing heads and a time bottleneck in production—resulting in a high polishing "cost factor." After switching to Red Brass-Formbrite, they use two polishing heads for a light cut and another for a simple color buff and run the machines faster. Savings run up to 40%. The secret of Formbrite is its superfine grain, produced by special rolling and annealing techniques. Formbrite is springier, harder, more scratch-resistant than the usual drawing brasses in the same standard tempers, yet retains remarkable ductility for forming and drawing. Despite its superiority, *Formbrite costs no more than ordinary drawing brass.* Get full details from your Anaconda representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

FORMBRITE

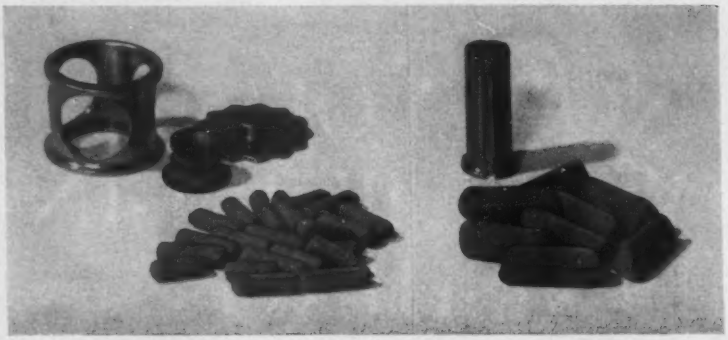
SUPERFINE-GRAIN DRAWING BRASS AN

ANACONDA®

product made by The American Brass Company

Barrel Finishing with Round and Triangular Abrasive Pins

Bonded media for abrasive tumbling, manufactured by the Norton Co., Worcester, Mass., now include round- and triangular-shaped pins. These abrasive pins were developed to finish intricate parts and hard-to-reach areas of serrated or grooved machined pieces previously difficult to finish completely with molded triangular- or spherical-shaped abrasives.



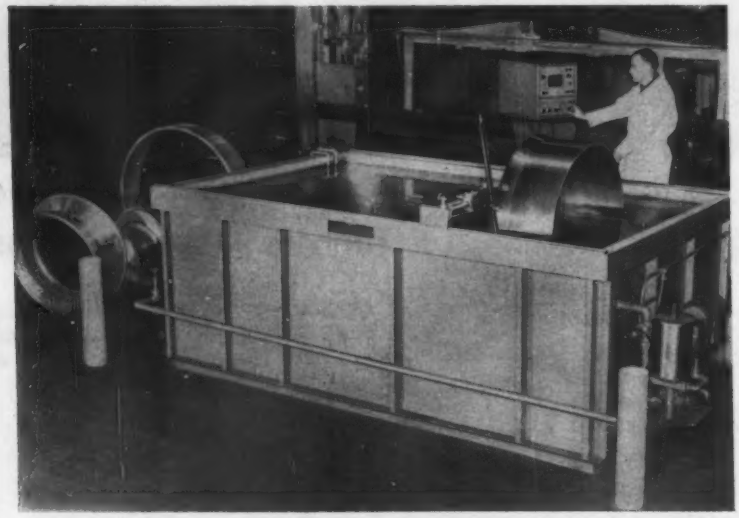
Norton round and triangular abrasive pins for barrel finishing

The new shapes are designated Tumblex RP (round pin) and Tumblex TP (triangular pin) abrasive. Round pins are available in standard 5/8-inch length and in diameters of 3/16 and 3/8 inch. Triangular pins are an inch long and 3/8 inch on the sides. The round abrasive pins are well suited to finishing parts with round holes or circumferential grooves; triangular ones are particularly adapted for finishing slotted parts. The 60-degree edge angle presented to the work gets into inside right-angle corners which square or round edges of other finishing media cannot touch. Both abrasive shapes are designed for the mass processing of ferrous and nonferrous metals, plastic, and rubber parts. They will remove burrs and scale resulting from heat-treatment, refine surfaces, and form radii.

Circle 575 on Readers' Service Card

Ultrasonic Immersion Testing Equipment Detects Flaws in Specialty Steels

The Standard Steel Works Division, Baldwin-Lima-Hamilton Corporation, Burnham, Pa., has just put in operation ultrasonic immersion testing equipment designed to provide rapid and sensitive location of internal flaws in specialty steels. This equipment, built by the Princeton Division, Curtiss-Wright Corporation, consists of: a special immersion tank 11 feet long by 6 feet 10 inches wide, with traveling bridge and scanner; search tube and manipulator; and an electronic control and indication "Immerscope" unit.



Operator at controls of Curtiss-Wright Immerscope for ultrasonic immersion testing equipment at plant of Standard Steel Works Division, Baldwin-Lima-Hamilton Corporation

The bridge arrangement affords both vertical and horizontal scanning to provide complete and rapid inspection. Both rollers and turntable are incorporated in the tank to permit the testing of a variety of pieces. Rollers, for instance, are used in testing large rings, while the turntable is employed for discs or wheels.

The equipment is so sensitive that defects as small as 1/64 inch can be detected as compared to 1/16 inch for the contact type testers. Because of the small initial pulse of the ultrasonic tester, only the first 1/64 inch of depth into the test-piece is lost or obscured in the initial pulse, while approximately the first inch is lost with contact type equipment.

The Immerscope generates an electrical pulse which is transformed into an ultrasonic signal by the transducer that is mounted on the end of the search tube (any of five test frequencies ranging from 2.25 to 25 megacycles). Portions of the ultrasonic signal are reflected from any surfaces, irregularities of discontinuities, in the test-piece and returned to the crystal, which transforms them back into electrical signals.

A synchronizer in the Immerscope times the echoes and provides range markers to indicate depth of echoes in the test-piece. Depth and relative size of discontinuities are determined from spacing and size of pips displayed on the cathode ray tube screen.

Circle 576 on Readers' Service Card

(This section continued on page 190)

DO YOUR OPERATIONS DEMAND ACCURATE CENTERS?

Ex-Cell-O Center Lapping Machines Increase Accuracy, Reduce Scrap!

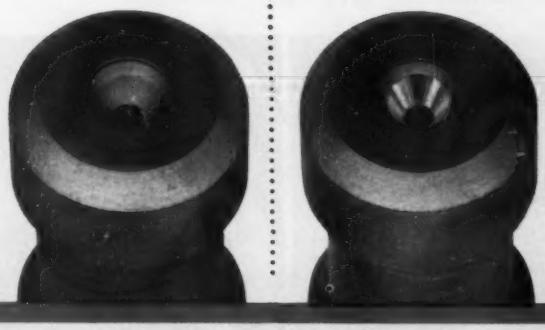
Precision Center Lapping Machines remove heat-treat scale, and eliminate roughness and distortion of centers to insure accuracy in subsequent operations.

Easy to use and modestly priced, Center Lapping Machines include as standard, inbuilt equipment Ex-Cell-O Precision Spindle and manual diamond dresser.

See your Ex-Cell-O Representative, or write for Bulletin 40271.

BEFORE LAPPING

- Out of line
- Out of round
- Incorrect angle
- Rough or torn



AFTER LAPPING

- Perfect alignment
- True roundness
- Precise angle
- Mirror-smooth

SEE EX-CELL-O'S BOOTH 946, NMTBA EXPOSITION

60-37

EX-CELL-O FOR PRECISION

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • ATOMIC ENERGY EQUIPMENT • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Air-Cushioned Vibratory Finishing Machine

A complete line of vibratory finishing equipment is being produced by the Pangborn Corporation, Hagerstown, Md. This new line centers about an air-cushioned vibratory finishing machine, distinguished by a suspension system similar to ones used successfully on busses and trucks. Four rubber air cushions are mounted above the vibrating platform; four, mounted below. Each series is pneumatically interconnected or manifolded and the air pressures are read on the operator's panel. Varying the pressure within the air-cushion system provides one means of regulating vibratory amplitude.

The same air-cushion equipment is available in floor mounts if desired. In this model, absence of floor vibration permits use of Pangborn machines in buildings where structural limitations prohibit operation of conventional floor-mounted machines.

Designed to replace and extend the application of tumbling and precision barrel finishing, this machine embodies simple, rugged, and compact design features, convenient and positive methods for controlling both frequency and amplitude of the vibratory work load. It is adaptable to cleaning, descaling, deburring, radiusing (to exact blueprint specifications), fine polishing, coloring, and burnishing. The process is suitable for practically all ferrous and nonferrous metals—castings, forgings, stampings, machined or pressed parts—and even many plastic and ceramic items.

Very large or extremely heavy pieces may be attached to a fixture for finishing. The time cycle is cut drastically when the fixture is supported by the stationary frame of the machine. The cycle is further reduced when the fixture is supported by the rim of the vibrating container. The vibratory process is said to extend the application of mechanical finishing to many new areas: intricate, fragile parts, such as electronic tube and textile machinery components easily bent and distorted in the tumbling slide in even the most gentle precision barrel-finishing machine, can be finished by the vibratory process.

Complex or tubular shapes have no effect on the vibratory process. Shielded areas and concave recesses can be reached with proper selection of media.

Vibration is generated by a short heavy-duty eccentric shaft mounted with minimum spacing between support bearings for maximum rigidity. Weights may be added or removed from the eccentric to change the vibratory amplitude. Connecting the eccentric with the stationary jack-shaft is a flexible annular type doughnut-shaped molded-rubber coupling designed to completely absorb shaft misalignment during vibration. Variable-pitch sheaves of the belt-driven wheel are adjustable to provide vibratory frequency control within a 2 to 1 ratio. This allows any speed setting within this range, such as between 1000 and 2000 rpm.

Optional equipment is available to provide infinite and automatic speed control where required. The air-cushioned vibratory finishing machines come in 1 1/2-, 3-, 6-, 12-, and 18-cubic-foot sizes. Larger models will soon be available.

Circle 577 on Readers' Service Card

Bendix Sonic-Energy Cleaning Equipment

Manufacturing costs of rotary electrical parts and assemblies have been substantially reduced enabling production increase through the use of sonic-energy cleaning equipment built by the Bendix Aviation Corporation, Pioneer-Central Division, Davenport, Iowa. This equipment has eliminated malfunctions and cleaning-solution hazards, permitting 120 pieces to be released from production each hour—three times as many as by the old cleaning method.

Equally important, you save on costs through the complete elimination of rework. Savings of over 87 per cent on cleaning-solution costs have been reported by using Bendix 25-I, an inexpensive water detergent replacing naphtha. The water detergent not only eliminates fire and explosion hazards, but the problems of skin irritations of personnel handling harsh solutions.

Circle 578 on Readers' Service Card

(This section continued on page 192)

Pangborn air-cushioned vibratory finishing machine for ferrous and nonferrous parts

Bendix sonic-energy equipment used for cleaning rotor and stator assemblies

RELIABILITY:

Reason enough to buy LeBlond

See LeBlond Booth 810 at the Machine Tool Exposition in Chicago, September 6—16.

Valuable as five fingers on a hand, these five great LeBlond lathes run round the clock, year in, year out, at the Warren, Ohio, shops of Wean Manufacturing Co. Wean has six LeBlonds in all, including the five in the picture, all purchased in the last five years.

The operations they perform are typically job-shop. Lots are small—five parts alike are a big run; materials may vary from hardened steel to copper. Fat mill rolls, long whippy spindles, sturdy stepped shafts—the rugged LeBlonds take them as they come and turn them quickly and accurately, regular as clockwork.

Much of Wean's output goes into steel mill equipment that can be relied on to hold up under the most exacting requirements—the same steadfast degree of reliability that LeBlond lathe customers expect, and get.

RELIABILITY is a good reason to buy a lathe. It is reason enough to buy LeBlond.

THE R. K. LEBLOND MACHINE TOOL COMPANY
Cincinnati 8, Ohio

LEBLOND *of Cincinnati*

For more data circle this page number on card at back of book

Ther-Monic Induction Heater Used in Testing Tensile Strength of Metal Alloys

A Ther-Monic compact and flexible induction heater with self-contained generator was developed recently for the General Electric Co. by the Induction Heating Corporation, Brooklyn, N. Y. It will be used in the experimental laboratories of G-E's Aircraft Nuclear Propulsion Department to test the tensile strength of metal alloys at extremely high temperatures. The heater was designed to meet the following requirements: compactness, to save space; versatility, so that more than one experiment could be carried on without the need of breakdown; safety devices for the protection of personnel, and of the unit itself.

To comply with these requirements, Ther-Monic's engineers used a basic "C" series, R. F. generator cabinet. Changes in the interior construction were made to allow for installation of a water-cooled 50-kw output, 10,000-cycle motor generator set; a full voltage motor starter; generator field supply; taped autotransformer for eight steps of voltage selection; power factor correcting capacitors, with both manual and automatic selectors; and complete controls and generator safety devices.

A tap selector switch, which permits a range of output voltages from 440 down to 110 in eight steps, is mounted on the outside of the unit. A control and instrument panel is mounted on the front of the cabinet to control and indicate all operations. The hinged panel (left) covers the ten stages of manual (rough) selection of power factor correction. The panel (right) permits push-button selection of seven fine correction adjustments, which can be made while the power is on, helping to simplify load adjustment. Both panels are electrically interlocked to shut off high-frequency power when opening power factor correction circuits.

Seven check lights—water off, overload, ground, door open, coil water temperature, capacitor water off, and standby—are continuous monitors, quickly pin-pointing any trouble areas, thereby simplifying correction. A bus-stud arrangement permits a matching transformer to be connected to either side of the cabinet so that two separate or entirely different experiments can be conducted simultaneously.

Circle 579 on Readers' Service Card

Black Diamond Drill Grinder

The Black Diamond Saw & Machine Works, Natick, Mass., has a newly designed drill grinder which will be distributed exclusively through the Edward Blake Co., Inc., Watertown, Mass. The drill grinder incorporates a number of advanced features said to give longer life and better performance.

A newly designed stand, with etched plate marked in increments, mounted on a dovetail slide permits the entire grinding wheel to be utilized. Since drills can be po-

Induction heater built by Induction Heating Corporation for General Electric Co.

Black Diamond drill grinder distributed by the Edward Blake Co., Inc.

Since 1948 many thousands of these Meehanite bearing housings have been produced by Otis Elevator Co., Ltd. for the railroads. They are made in type GM Meehanite and flame hardened.

UNIFORMITY... casting after casting

Meehanite's exclusive manufacturing process gives you positive assurance of always getting clean, sound castings with uniform structure and properties in all sections . . . in every casting . . . in every group of castings. This ability to control quality and uniformity saves you time and money in your shop and results in dependable performance in service.

Avoid the risk of hidden defects which cause high machining costs and casting rejects. Don't take a chance on bargain prices or so-called "equivalents." Specify Meehanite metal and be sure of obtaining castings that do the job better.

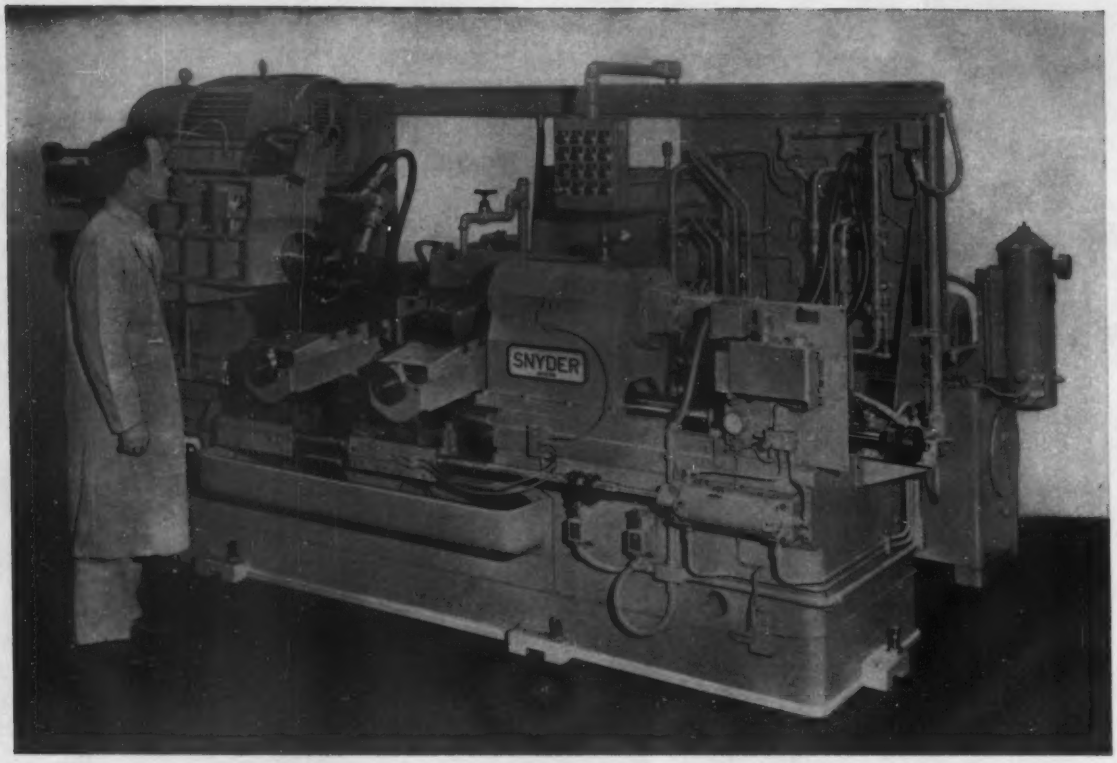
There are 30 types of Meehanite metal—each made to its own structural constitution and possessing its own combination of engineering properties. Why not have a field engineer from a Meehanite foundry help you select the one type that will most completely meet your design and service requirements. Check the Meehanite foundries listed below for the one nearest you. You'll like doing business with a Meehanite foundry.

Write today for your free single copy of the Meehanite Wall Chart. It contains complete specifications on many types of Meehanite.

MEEHANITE METAL

The American Laundry Machinery Co., Rochester, N. Y.
Atlas Foundry Co., Detroit, Mich.
Banner Iron Works, St. Louis, Mo.
Barnett Foundry & Machine Co., Irvington, N. J.
Casting Service Corp., LaPorte, Indiana and Bridgman, Michigan
Centrifugally Cast Products Div., The Shenango Furnace Co., Dover, Ohio
Compton Foundry, Compton, Calif.
The Cooper-Bessemer Corp., Mt. Vernon, Ohio and Grove City, Pa.
Crawford & Doherty Foundry Co., Portland, Ore.
Dayton Casting Co., Dayton, Ohio
Empire Foundry Co., Tulsa, Okla.
Florence Pipe Foundry & Machine Co., Florence, N. J.
Fulton Foundry & Machines Co., Inc., Cleveland, Ohio
General Foundry & Mfg., Flint, Mich.
Georgia Iron Works, Augusta, Ga.
Greenlee Foundries, Inc., Chicago, Ill.
Hamilton Foundry Inc., Hamilton, Ohio
Johnstone Foundries, Inc., Grove City, Pa.
Kanawha Manufacturing Co., Charleston, W. Va.
Kennedy Van Saun Mfg. & Eng. Corp., Danville, Pa.
Lincoln Foundry Corp., Los Angeles, Calif.
Oil City Iron Works, Corsicana, Texas
Palmyra Foundry Co., Inc., Palmyra, N. J.
The Henry Perkins Co., Bridgewater, Mass.
Pohlman Foundry Co., Inc., Buffalo, N. Y.
Rosedale Foundry & Machine Co., Pittsburgh, Pa.
Ross-Meehan Foundries, Chattanooga, Tenn.
Sonith Foundries of FMC, Indianapolis, Ind.
Standard Foundry Co., Worcester, Mass.
The Stearns-Roger Mfg. Co., Denver, Colo.
Vulcan Foundry Co., Oakland, Calif.
Washington Iron Works, Seattle, Wash.
Dorr-Oliver-Long, Ltd., Orillia, Ontario
Hartley Foundry Div., London Concrete Machinery Co., Ltd., Brantford, Ontario
Otis Elevator Co., Ltd., Hamilton, Ontario

MEEHANITE METAL CORPORATION, NEW ROCHELLE, NEW YORK



Snyder special heavy-duty automatic lathe that rough-turns and faces eight different forged-steel automotive axle-shafts at a rate of 105 pieces per hour

sitioned for grinding at any point on the face of the wheel, excessive wheel wear is eliminated, giving it longer life.

A new turret type quadrant swings the desired drill locator into direct line with the swinging arm of the grinder, resulting in easier, faster operation and less operator fatigue. Diamonds in the wheel dressers are presented to the grinding wheel at a 15-degree angle for self sharpening. A larger, more rugged web thinner is used to assure higher accuracy and better results in producing a crankshaft or "Colton" point. The new diamond dresser is applied to the periphery of the wheel at a 5-degree angle, assuring sharp wheel edges for web thinning. A positive lock, mounted on the motor base, eliminates the need for loosening and tightening bolts when dressing the wheel. Mist coolant is used to improve finish and give longer wheel life. The grinder has a new desk-height, knee-hole, four-drawer cabinet (not shown).

Circle 580 on Readers' Service Card

Snyder Special Heavy-Duty Lathe Equipped to Process Eight Different Forgings

A special automatic lathe that completely rough-turns and faces eight different lengths and diameters of forged-steel automotive axle-shafts with carbide tools at a rate of 105 pieces per hour is now available from the Snyder Corporation, Detroit, Mich. The machine rough straddle-faces the flange; rough-turns the flange, oil-seal, and bearing diameters; rough-turns the flange-pilot diameter; and rough-turns the spline diameter on the opposite end of the shaft.

A hydraulic-cylinder-operated overhead slide is tooled to machine the flange pilot. Tools in a rear slide, fed in by a hydraulic cylinder, straddle-face the flange. Two pivot-mounted turning slides at the front of the work are independently rocked downward to permit loading and unloading the work. Hydraulic-cylinder-operated cams raise the slides into adjustable micrometer stop positions for the turning operation. Axial-slide advance to the left for turning is made by another hydraulic cylinder. A 40-hp motor drives the headstock through an externally mounted air brake and clutch mechanism that permits stopping and starting of the drive spindle within one second.

The shaft is manually loaded on the machine by means of approximate locators that enable the operator to bring the push-button-operated, hydraulic-cylinder-actuated tailstock center into contact with the part. The tailstock is locked in position by a manual clamp control. A separate motorized hydraulic pump and tank unit provides hydraulic power for the machine. The entire machine and tank unit occupy a floor space approximately 12 1/2 by 9 feet. An integral coolant system is included with the machine.

Circle 581 on Readers' Service Card

(Continued on page 209)

What's new in METALWORKING?

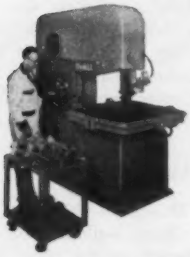
...See Your Local DoALL Representative

and see demonstrations during Machine Tool Exposition

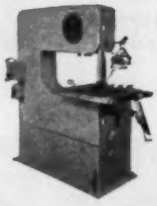
Keep up with the important news that will save you time and money in your manufacturing operations! See all the new DoALL developments now available in band sawing, surface grinding, slicing, precision measuring instruments and cutting tools.

BAND SAWING

See the whole line-up of all-new machines—in a complete range of sizes and types. Throat capacities from 16" to 60", and priced to suit every need in the shop or on the production line.



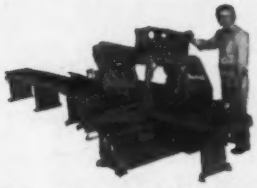
Contour-matic®
—revolutionizes contour machining by employing high-speed steel saw bands, power feed table and inbuilt coolant system. Easily fixtured for duplicate part production.



Utility Machine
—versatile, low-cost unit for shop use—manually operated.

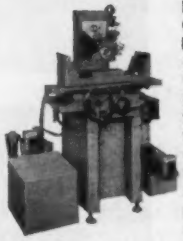
High-Speed Zephyr
—rugged, high-speed sawing machine for nonferrous materials and friction sawing of ferrous metals.

CUT-OFF SAWING



DoALL Power Saws are the world's fastest cut-off machines employing high-speed steel saw bands. Available in low-cost manual models or full automatics with capacities up to 24".

SURFACE GRINDING



DoALL Surface Grinders range from low-cost manual units to hydraulic high-production models. They feature ease of operation with accuracy obtained directly from handwheel settings. Also available, a full line of accessories for cylindrical and form grinding operations.

Galaxy of New SAW BANDS

—to cut every metal and material.

Your DoALL Store carries the largest and most complete stock of saw bands—over 300 width-pitch-set combinations, 21 styles—in both carbon and high-speed steel; also diamond-edged and special types. Also available: a wide selection of file bands, grinding bands, polishing bands. Use your DoALL Store for your complete saw band service.

PRECISION MEASURING

S-7A

Most modern and complete line of precision measuring equipment including new stainless steel gage blocks, comparators, double-faced, reversible black granite surface plates, and inspection tools—all made to the highest quality standards.

CUTTING TOOLS, STEEL, COOLANT

Let your local DoALL Store carry your tool inventory—assure quick delivery and lower costs on thousands of different items, both standard and special—all guaranteed. Ask also about DoALL precision ground tool and die steel, DoALL cutting fluids and other industrial supplies.

The DoALL Company, Des Plaines, Illinois

This is a typical DoALL Store

For more data circle this page number on card at back of book

NEW CATALOGUES

• Yours for the asking . . . Use postcard inside back cover

Self-Locking Screws and Bolts

Continental Screw Co., New Bedford, Mass. "One-Piece Self-Locking Screws and Bolts" explains low assembly costs afforded by Holtite Nylok fasteners. Contains manufacturing standards giving Nylok insert diameter, location, protrusion, torque, etc.

Circle **Item 501** on Inquiry Card

Induction-Heating Machine

Meta-Dynamics Division, Cincinnati Milling Machine Co., Cincinnati, Ohio. Publication M-2144 describes the MG Inductron, a motor-generator induction-heating machine for soldering, tempering, selective hardening, bonding, annealing, and brazing.

Circle **Item 507** on Inquiry Card

Auto-collimator

Gaertner Scientific Corporation, Chicago, Ill. Bulletin 205-60, on new auto-collimator for precision measurement of angular position and small linear displacements. Describes how instrument combines functions of collimator and telescope.

Circle **Item 502** on Inquiry Card

Induction Motors

General Electric Co., Schenectady, N. Y. "Tri-Clad 55 Motor Selection and Buying Information" is title of Bulletin GEC-1049. Chart gives types recommended for various loads and ambient conditions. Tables show dimensions and other data.

Circle **Item 508** on Inquiry Card

Automatic Parts Assembler

USI Robodyne Division, U. S. Industries, Inc., Silver Spring, Md. "TransfeRobot" bulletin on design and operation of automatic parts assembler, as well as the simple means of programming and setup, permitting quick changes from job to job.

Circle **Item 503** on Inquiry Card

Band-Sawing Machine

Henry G. Thompson & Son Co., New Haven, Conn. Bulletin 502 on the Milband machine for fast and accurate sawing. Describes equipment's hydraulic feed, infinitely variable speed range, recirculating coolant system, and automatic operation.

Circle **Item 509** on Inquiry Card

Wheels for Welders

Norton Co., Worcester, Mass. "Grinding Wheels for the Welding Trade" tells how each type of grinding wheel in this field is used, and gives its properties. Illustrations and tables amplify the text. Literature includes a net price supplement.

Circle **Item 504** on Inquiry Card

Adjustable Perforating Dies

S. B. Whistler & Sons, Inc., Buffalo, N. Y. Catalogue 60 on adjustable dies for perforating and notching materials up through 1/4 inch in mild steel. Data on die assembly and tee-slot die sets and punch diameters from 1/32 to 3 inches.

Circle **Item 510** on Inquiry Card

Band Mill

DoALL Co., Des Plaines, Ill. Catalogue on the Band Mill tells how the equipment is specifically designed for heavy and large work. Typical applications are illustrated, and specifications include blueprint views and dimensions.

Circle **Item 505** on Inquiry Card

Socket-Head Screws

Bristol Co., Waterbury, Conn. Catalogue 765 describes hexagon socket and multiple-spline socket cap-screws and set-screws, with physical properties and dimensional standards. Data given on pipe plugs, dowel pins, and socket-screw keys.

Circle **Item 511** on Inquiry Card

Gear Chucks

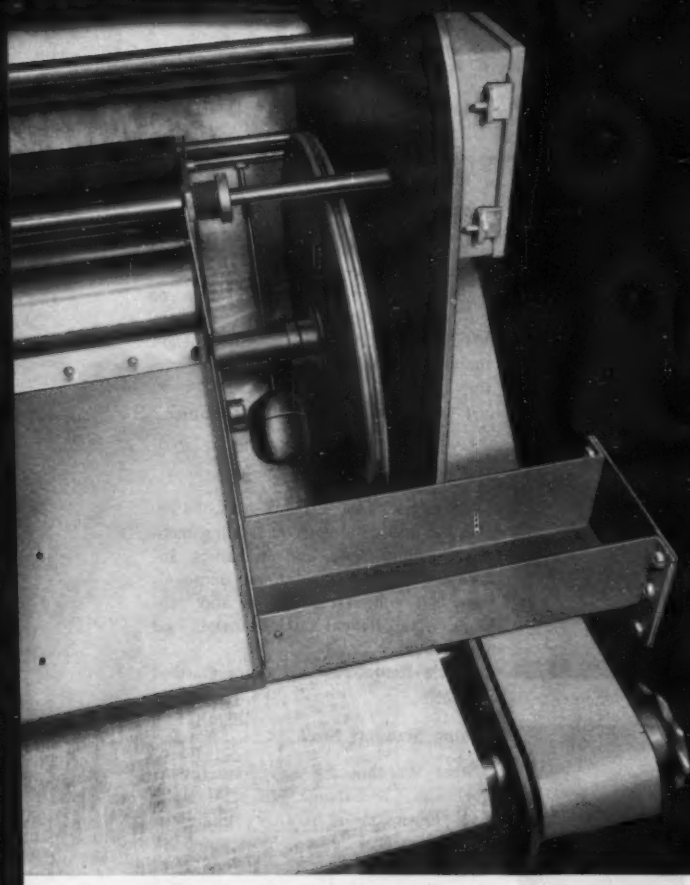
Erickson Tool Co., Solon, Ohio. Section M on spring-jaw gear chucks. Describes automatic, self-compensating spring jaws, two-level chucking, single-row and two-level types, interchangeable jaws, locating pins, and end stops.

Circle **Item 506** on Inquiry Card

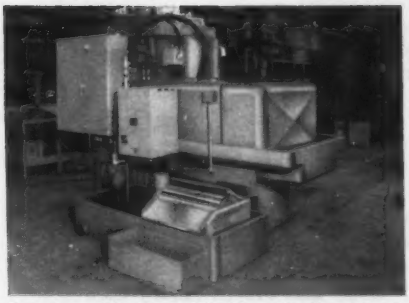
Drills, Reamers, and End Mills

Chicago-Latrobe, Chicago, Ill. Catalogue 60 gives sizes and prices of company's carbon steel, high-speed steel, and carbide twist drills, reamers, end mills, countersinks, counterbores, tool bits, screw extractors, lathe centers, etc.

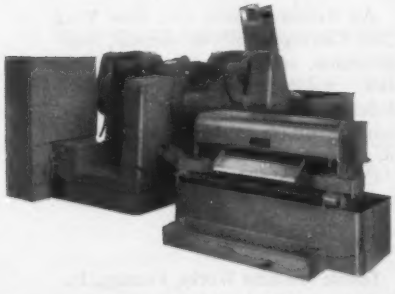
Circle **Item 512** on Inquiry Card



HERE'S WHY BARNESDRIL COOLANT CLEANING EQUIPMENT DOES A BETTER JOB... AND AT LESS COST



Note how this Barnesdril Magnetic Separator is mounted in the coolant tank of a rotary surface grinder.



Compact installation of a Barnesdril Kleenall Combination Filter and Separator on a double disc grinder.

For Grinding, Honing, Gear-Cutting . . . or any similar operation requiring an abundant supply of clean, grit-free coolant . . . your best bet is a BarnesdriL Unit for *automatic* sludge removal. Here's why..

Compact Design

requires less floor space . . . often permits installation of BarnesdriL Units in the machines' outside coolant tank.

No Jets, Tubes, or Screens to Clog

and impair cleaning efficiency. And, the BarnesdriL gentle action system prevents particles from being forced through the filter.

Low-Cost Filter Fabrics

actually increase in efficiency as swarf builds up on the filter media, which accounts for the low consumption of fabric on BarnesdriL Filters. Our laboratory technicians will select the correct filter fabric for your job application.

Powerful Magnetic Field

For every 5 g.p.m. coolant capacity, BarnesdriL Separators pack eight pounds of permanent Alnico magnets — the strongest magnetic attraction possible.

Three Models in a Wide Range of Capacities

BarnesdriL Kleenall Filters, Combination Magnetic and Fabric Filters, and Magnetic Separators range in capacity from 1½ to 120 gallons per minute. Specially engineered Central Systems are also available!

WRITE FOR KLEENALL BULLETIN 100 TODAY!

BARNESDRIL FILTRATION UNITS

Honing Machines / Production Units / Filtration Units / Drilling Machines

BARNES DRILL CO.

820 Chestnut Street • Rockford, Illinois

DETROIT OFFICE — 13121 Puritan Avenue

• Yours for the asking . . . Use postcard inside back cover

Broaching Tools

National Broach & Machine Co., Detroit, Mich. "Cut Broaching Costs with Red Ring Tools and Fixtures" explains how successful broaching depends on good tool design; shows facilities for imparting extra hardness with the Naloy process.

Circle **Item 513** on Inquiry Card

Cutoff Machines

Modern Machine Tool Co., Jackson, Mich. Catalogue lg/Mo describes machines which cut off, chamfer, groove, and form tubing and bars in a single, fast operation. Also covers hot spinning machines which cut, close, and weld one end of the work.

Circle **Item 514** on Inquiry Card

Second-Operation Machines

Universal-Automatic Corporation, Schiller Park, Ill. Bulletin tells how automatic machines and systems effectively handle secondary operations. Describes modular construction having a "brain" and work-holding fixtures and feed mechanisms.

Circle **Item 515** on Inquiry Card

Mill with Throw-Away Inserts

Wesson Co., Detroit, Mich. Bulletin on "Industry's First Cutter Using Micro-Adjustable Throwaway Inserts." Describes how inserts are individually adjustable to 0.0001 inch; how inserts are supported axially by a tapered lock-pin.

Circle **Item 516** on Inquiry Card

Controlled Air Power

Bellows Co., Akron, Ohio. "A Panorama of Production Ideas Using Bellows Controlled-Air-Power" tells how pneumatic units operate vises, feed stock, feed machine slides, power conveyors, operate collets, index-tables, transfer and package materials.

Circle **Item 517** on Inquiry Card

Scan-o-matic Tracing

Tree Tool & Die Works, Racine, Wis. Bulletin tells how Scan-o-matic system applied to Tree 2UVR and 2VG milling machines operates automatically for three-dimensional duplication, or semi-automatically for profiling, with constant feed rate.

Circle **Item 518** on Inquiry Card

Metal-Arc Welding

Air Reduction Sales Co., New York City. Catalogue 2350 on Aircomatic welding equipment includes data on pull guns and push guns, wire feeders, MIGet gun and control, welding heads, machines, shielding gases, and regulators.

Circle **Item 519** on Inquiry Card

Lapping Equipment

American Lap Co., Detroit, Mich. Manual and catalogue on lapping techniques, laps, tools, and machines. Information on fast stock removal; standards on external laps and lapholders, and helical slot expansion laps and arbors.

Circle **Item 520** on Inquiry Card

Cutting Stainless Steel

Steel Warehousing Division, Jessop Steel Co., Broadview, Ill. "A Bold New Direction in Cutting Stainless Steel" concerns cost-saving potential and metallurgical advantages of cutting stainless-steel plate by the tungsten-arc process.

Circle **Item 521** on Inquiry Card

Pre-Honed Inserts

Metallurgical Products Department, General Electric Co., Detroit, Mich. "How to Get Better Profits Through Better Tooling with G-E Pre-Honed Carboloy Inserts" tells how honing puts more material at the edge under compression.

Circle **Item 522** on Inquiry Card

Tungsten-Arc Welding

Air Reduction Sales Co., New York City. Catalogue 2300 on manual, semi-automatic, and automatic Airco Heliweld welding equipment. Contains data on two new holders and automatic heads, a manual welding outfit, electrodes, and accessories.

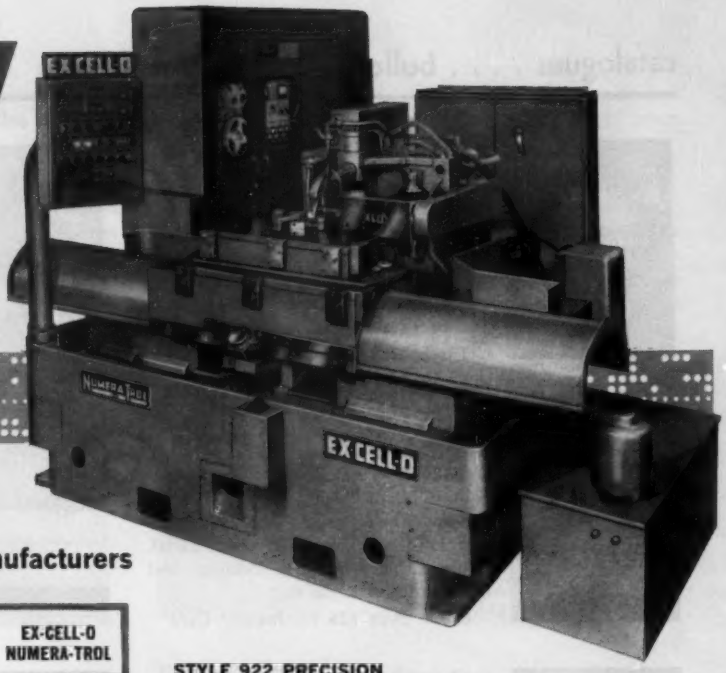
Circle **Item 523** on Inquiry Card

Contract Machining

Textile Machine Works, Reading, Pa. Brochure on Contract Division itemizes and illustrates facilities available for designing, machining, heat-treating, plating, tumbling, tool and die making, materials testing, assembling, and quality control.

Circle **Item 524** on Inquiry Card

a study in time



How Ex-Cell-O Numera-Trol Cuts Costs for Three Modern Manufacturers

Part: TEMPLETS	CONVENTIONAL METHODS	EX-CELL-O NUMERA-TROL
Lead time	128 hrs.	16 hrs.
Grinding per/piece	60 hrs.	6 hrs.
TIME SAVED	166 HOURS	

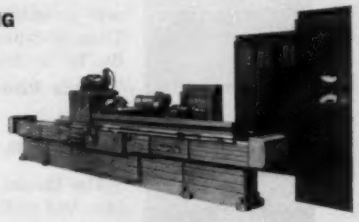
Part: FUEL CONTROL CAMS	CONVENTIONAL METHODS	EX-CELL-O NUMERA-TROL
Lead time	150 hrs.	40 hrs.
Machining per/piece	80 hrs.	7.5 hrs.
TIME SAVED	182.5 HOURS	

Part: STEAM TURBINE BUCKETS	CONVENTIONAL METHODS	EX-CELL-O NUMERA-TROL
Lead time	144 hrs.	24 hrs.
Machining per/piece	90 hrs.	12 hrs.
TIME SAVED	198 HOURS	

STYLE 922 PRECISION CONTOURING MACHINE
Slides are controllable to .000025". Grinding unit is interchangeable with boring and turning unit.

PRECISION CAM-MILLING MACHINE
Slashes lead time in producing drum-type cams.

PRECISION PROFILING MACHINE
Performs intricate and accurate milling and grinding of 3-dimensional forms.



Are you faced with tough prototypes or production parts that "can't" be produced economically? See your Ex-Cell-O Representative, or write direct for details on how you can apply Ex-Cell-O's Numera-Trol system of tape-controlled precision machine tools to do more jobs, faster and more accurately!

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Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

SEE EX-CELL-O'S BOOTH 946, NMTBA EXPOSITION

• Yours for the asking . . . Use postcard inside back cover

Piston Pumps

Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio. Brochure on Series 30, 40, and 60 axial piston pumps in both constant- and variable-volume models. Gives performance and torque curves, schematics of pumping techniques, etc.

Circle **Item 525** on Inquiry Card

Bending Brakes

Lake Erie Machinery Corporation, Buffalo, N. Y. Describes principle and equipment of "Form-All" for radius bends, closed shapes, channels, corrugations, and angles in sheet metal. Explains deep-channel forming and floating dowel angle stop.

Circle **Item 526** on Inquiry Card

Lead Analyzer

Star Cutter Co., Farmington, Mich. Bulletin on universal precision lead analyzer for checking hobs, helical gears and splines, spiral-gashed milling cutters, worms, screws, and drum cams. Shows how a transducer head picks up variations in timing and charts it.

Circle **Item 527** on Inquiry Card

Chilling Equipment

Cincinnati Sub Zero Products, Cincinnati, Ohio. Bulletin on production chilling equipment for stabilization of metals, stress relief of castings, expansion assembly, and other applications. Thermal capacities from 500 to 10,000 Btu/hr. as low as —150 degrees F.

Circle **Item 528** on Inquiry Card

Portable Mill

The Dumore Co., Racine, Wis. Bulletin VM-60-C describes three sizes of portable Versa-Mils for low-cost milling, slotting, boring, shaping, grinding, and related operations on any size work. Has design features, specifications, attachments, and arbors.

Circle **Item 529** on Inquiry Card

Transfer Punches

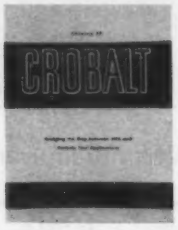
Kelly Tool & Mfg. Co., Los Angeles, Calif. Bulletin on expanding transfer punches, consisting of a set of three which fit any diameter hole from 1/4 to 11/16 inch. Explains how design allows transfers to be made even from thin shim stock.

Circle **Item 530** on Inquiry Card

V-Belts

Raybestos-Manhattan, Inc., Passaic, N. J. Bulletin M 220 on CX molded V-belts for small sheave diameters operating on short centers and at high speeds. Explains how molded notches give flexibility, permit controlled compression around sheave.

Circle **Item 531** on Inquiry Card



Cast Alloy Tools

Crobalt, Inc., Ann Arbor, Mich. Catalogue on cast alloy cutting tools explains advantages of the material, the analysis of the grades offered, and specifications of available bits, blades, and tool-holders. Complete specifications and diagram of each tool.

Circle **Item 532** on Inquiry Card

Collets and Collet Fixtures

Zagar Inc., Cleveland, Ohio. Bulletin tells how collets and collet fixtures can increase production of small parts. Illustrations include basic collet fixture, indexing fixture, lathe chuck, and air-operated and cam-operated fixtures. Collets available in various designs.

Circle **Item 533** on Inquiry Card

Cam Solutions

Eonic Inc., Detroit, Mich. Bulletin 105 tells how to save time on cam engineering problems by using company's digital computer. Problems are solved economically through a library of programs as standards for cams in use today.

Circle **Item 534** on Inquiry Card

Abrasive Saws

Beaver Pipe Tools, Inc., Warren, Ohio. Specifications on various "Speed Cut" abrasive cutting machines. Dry-cutting and wet-cutting models, "any-angle" machines, oscillating-head machines, automated machines, and trailer models.

Circle **Item 535** on Inquiry Card

Band-Saw Blades

Millers Falls Co., Greenfield, Mass. Specifications on alloy-steel band-saw blades containing vanadium carbide, said to match the performance of high-speed steel blades, but cost 25 per cent less. Gives blade speeds for carbon, alloy, and tool steels.

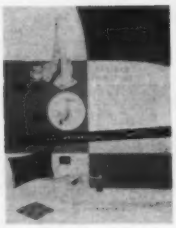
Circle **Item 536** on Inquiry Card

• Yours for the asking . . . Use postcard inside back cover

Internal Grinding Wheels

Cincinnati Milling Products Division, Cincinnati, Ohio. Booklet PG-354 describes characteristics of wheels for internal grinding. Features include positive duplication, cool cutting, minimum dressing, accurate dimensions, and uniform wear.

Circle **Item 537** on Inquiry Card



Toggle Clamps

Detroit Stamping Co., Detroit, Mich. Bulletin 102105 describes De-Sta-Co Series 102 vertical-handle toggle clamps. These are designed for aircraft and electronic pegboard assembly fixtures. Also described is a new base for the Series 105 clamps.

Circle **Item 538** on Inquiry Card

Pressroom Equipment

U. S. Tool Co., Inc., Ampere, N. J. Bulletin 85-60 describes slide feeds, roll feeds, air-operated feeds, flat-stock straighteners, stock reels, coil cradles, combination cradle straighteners, Multi-stops, scrap choppers, and stock oilers.

Circle **Item 539** on Inquiry Card

Cam-Operated Machines

Earl A. Thompson Mfg. Co., Ferndale, Mich. Bulletin 22-A on Hydra-Cam machines. Gives advantages of cam design where multiple functions require power and control. Explains principle of oil column hydraulic linkages with rotary cam actuation.

Circle **Item 540** on Inquiry Card

Dust Collectors

Hammond Machinery Builders, Inc., Kalamazoo, Mich. Catalogue DK-280 tells how dust-, dirt-, and mist-collecting problems can be solved with DusKolectors. Installation recommendations, illustrations, cut-away diagrams, floor plans, are included.

Circle **Item 541** on Inquiry Card

Fluid Couplings

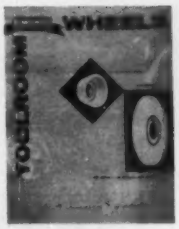
Twin Disc Clutch Co., Racine, Wis. Bulletin 144-E gives details on fluid couplings for OEM application, as well as package units for consumer use. Performance characteristics with internal combustion engines and electric motors are included.

Circle **Item 542** on Inquiry Card

Air Cylinders

Tomkins-Johnson Co., Jackson, Mich. Bulletin SQ-3-60 on increased range of T-J Squair head cylinders, giving bore sizes, rod dimensions, maximum strokes, mounting dimensions, and other data; and a cut-away view explaining principles.

Circle **Item 543** on Inquiry Card



Abrasive Wheels

Simonds Abrasive Co., Philadelphia, Pa. Form ESA-272 on wheels for tool and cutter grinding and for surface grinding. SA Borolon vitrified bonded wheels, WA Borolon white wheels, GC Electrolon silicon carbide wheels, and diamond wheels.

Circle Item **544** on Inquiry Card

Hole Punches

Punch Products Corporation, Buffalo, N. Y. Series AJ Unipunch hole-punching units with all-steel holders. Bulletin gives holder width, throat depth, etc., for three units having (maximum) punch size of 0.4375, 0.625, and 0.875 inch, respectively.

Circle **Item 545** on Inquiry Card

Solid Carbide Tools

Precision Carbide Co., Paterson, N. J. Catalogue and Manual 59 gives sizes and data on Pre-Carb solid carbide twist drills, burrs, end mills, chucking reamers, internal grinding tools, center laps, boring tools, and countersinks.

Circle **Item 546** on Inquiry Card

Height Gages

Cadillac Gage Co., Detroit, Mich. Booklet describes line of Pla-Chek gages for use on surface plates. Data given on six models, with the Cadillac thread analyzer and Super-Chek also described. Illustrations show devices in use.

Circle **Item 547** on Inquiry Card

Slim Bearings

Kaydon Engineering Corporation, Muskegon, Mich. Bulletin S-112 contains engineering drawings for mounting Reali-Slim bearings in a transmission, throttle control, radar rotary joint, submarine periscope, and other applications.

Circle **Item 548** on Inquiry Card

Report to the **SMTS*** *Committee*

*SPECIAL MACHINE TOOL STANDARDS

DELIVERY:

MMT-PE SEE SMTS ECONOMATICS • BOOTH 1440 MACHINE TOOL EXPOSITION

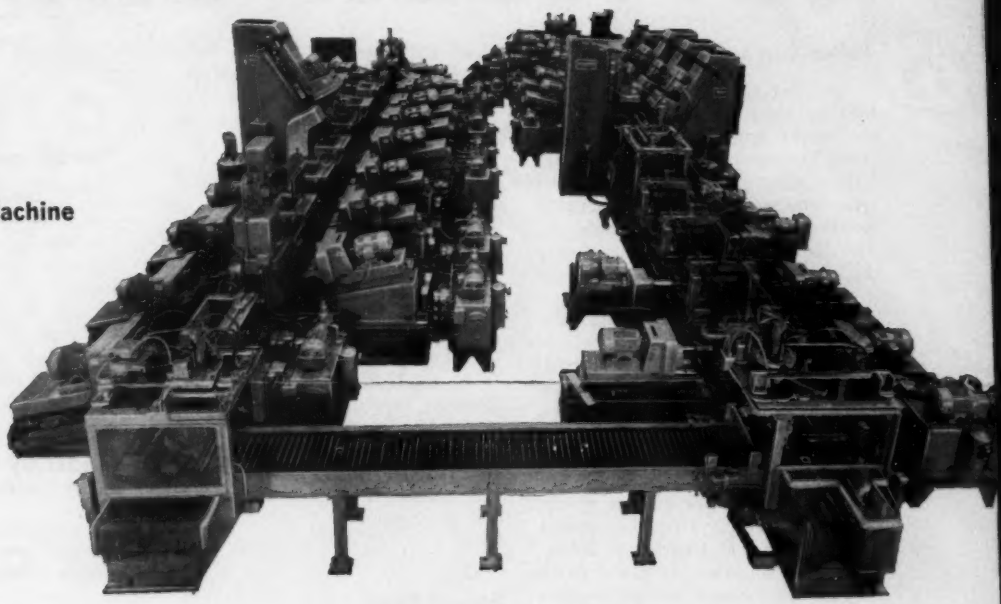
BUHR'S "BABY"

arrives on time . . .

Weight: **500 tons**

Length: **220 feet**

Genus: **Transfer Machine**



What's all the excitement about? Buhr's Baby, the first major machine built to the Special Machine Tool Standards, has been delivered to its proud owner—a major American automobile manufacturer. And it's some baby!

A lift-and-carry, part-through transfer, with fifty-eight stations, the machine is designed to perform 323 precision operations in automatic sequence on cylinder heads for a 1961 model automotive engine. Operations, in addition to rough and finish machining, include probing, sealer application, assembling, pressure testing, rejecting and injecting . . . you name it. It's fast, too. The work cycle is only 30.0 seconds. Capacity at 100% efficiency is 120 pieces per hour. It's some baby, alright! Because it was built to the new Standards, it's the most flexible and readily convertible multiple operation machine tool ever built. It's the first in a broad new line of SMTS Babies that Buhr is now building.

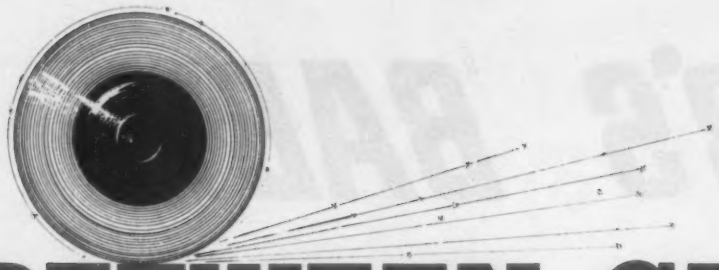
BUHR

(say BURE)

ECONOMATIC

BUHR MACHINE TOOL COMPANY • ANN ARBOR, MICHIGAN

For more data circle this page number on card at back of book



By E. S. Salichs

BETWEEN GRINDS

Takes Sun to Run

The first solar automobile in history was exhibited in Chicago during the recent American Power Conference. The sun-powered car is a 1912 Baker electric adapted to utilize solar energy by the International Rectifier Corporation of California. The thought occurred to us that if the sun went under a cloud, the car would stall, but we were relieved to learn that such is not the case. The sunlight energizes 10,000 silicon solar cells mounted on the car roof, charging a 72-volt battery system. The car then works off the batteries.

Jet Jaunt

A six-month sales contest at the Brown & Sharpe Mfg. Co. ended with Raymond F. Charlebois, a machine tool salesman, as grand prize winner, the award an all-expense paid vacation for two at a place of his (or his wife's) choice. So Mr. Charlebois, accompanied by his wife, took off from Boston by jet plane to California, and with an easy mind, because the vice-president and general manager of the Machine Tool Division, Wallace B. Bainton, took over his calls on customers. Happy holiday, Mr. and Mrs. C.

Fair Warning to Fathers

At the annual American toy trade fair held recently, a producer of electronic equipment in kit form announced its entry in the toy field with kits scaled to junior talents, all to be ready for Santa's 1960 sock. Three "electronic experimenters' laboratories" will provide material to build transistor audio amplifiers and radios, intercom systems, burglar alarms, TV silencers, and the like. Bone up now if you are buying later!

Poison Pure

Ultra-pure arsenic is moving into prominence as a vital element of semiconductors, according to *News and Progress in Metals*. What a relief! We always did worry whether those doses of arsenic Ma was giving Pa were up to par, but never liked to ask, and he never told us.

The Littlest Lamp

The smallest incandescent lamp ever produced on an assembly line has been placed into production by Sylvania Lighting Products. "Mite-T-Lite" is small enough to pass through the eye of a darning needle. Just imagine a darning needle, which is probably what you will have to do since you won't be able to find one in the house.

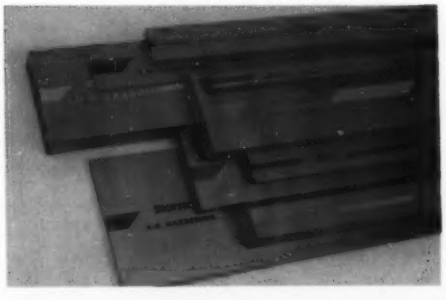
Tender by Guess or Tried by Press

A hydraulic press developed by the United States Department of Agriculture is being used to measure the toughness of raw meat. In other words, if your steak has a pressure reading greater than 300 psi, you had better sharpen the knives. Are the tough cuts really being ticketed "Enjaw yourself, it's tougher than you think"?

PATENTS AND PROGRESS—At the opening ceremonies in Washington, D. C., of the Mechanical Exhibit sponsored by the United States Patent Office are seen (left to right) Hayward A. Gay, vice-president of the Cincinnati Milling Machine Co.; the Honorable Robert C. Watson, Commissioner of Patents; Lincoln E. Mehlhope, manager of the patent department of Cincinnati Milling; and the Honorable Frederick H. Mueller, Secretary of the United States Department of Commerce. Mr. Mehlhope is demonstrating to his interested audience how vibration, the enemy of smooth finish, is eliminated through the use of a patented wheel-balancing mechanism applied to a Cincinnati precision grinding machine. Later, many visitors operated the unit at the Exhibit, which ran almost a month. Seventeen major companies covering industrial products protected by U.S. patents participated in the Exhibit, and showed by example how the Patent System has fostered innovations in the field of mechanical devices.

PRECISION MEASURING TOOLS — Micrometer Caliper Set No. S436E-RL, 0-12" Range illustrated above

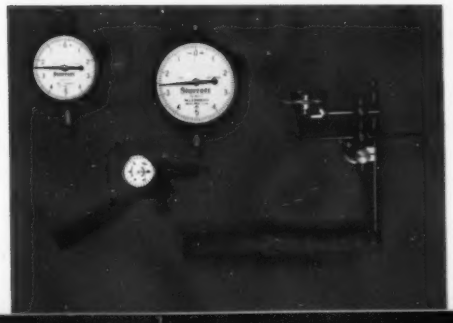
Starrett® for measuring ease no other tools can match



Only Starrett offers the complete range of sizes and types that lets you choose the right tool for any measuring job. No other make can match Starrett perfection of design with every feature precisely right for better, faster precision measuring.

Your nearby Industrial Supply Distributor stocks a complete line of Starrett products all made to the same high standards of quality. Write for complete catalog No. 27. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U. S. A. . . .

World's Greatest Toolmakers



PRECISION GROUND DIE AND FLAT STOCK
DIAL INDICATORS AND GAGES
HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES

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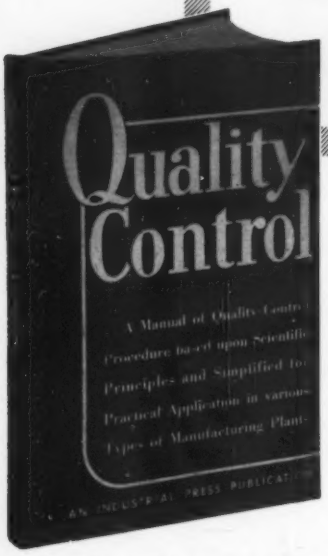
Fourth Edition

IMPROVE YOUR PRODUCT REDUCE COSTS TOO!



New fourth edition—simplified for practical application—presents the latest and best techniques of statistical quality control:

- **Statistical evaluation of tolerances**
- **Process investigation (evolutionary operation to achieve optimum quality and production)**
- **Ready-made sampling plans**
- **Control charts**
- **Illustrations and step-by-step examples**
- **Tabulated data**

Quality Control is an up-to-date manual that is simpler yet more complete than any other text on this subject. It is, first and foremost, a practical working tool that contains easy-to-read data, ready to be applied in every kind of manufacturing plant. Emphasis is on clarity. Modern methods of statistical quality control are explained in simple terms and step-by-step examples. Wherever possible, computations have been replaced with ready-made tabular data. The new fourth edition explains the use of statistical evaluation of tolerances as an aid in establishing and maintaining realistic tolerance specifications. It also describes a new technique on process investigation and evaluation that will help you find the process settings that will yield optimum quality and productivity. The author, Norbert L. Enrick, is well known as a consultant for over a hundred industrial plants, and as a teacher of quality control. He has carefully selected illustrations from his work in the metalworking, electronic, chemical, food and textile industries as examples of the scientific principles and methods he sets forth.

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• Charts based on maximum and minimum specifications. • Charts based on average specifications. • Special charts for old and worn equipment. • Charts for defects control. • Charts for control of machine efficiency and productivity.

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COUNTERBORING

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FACE MILLING

END MILLING

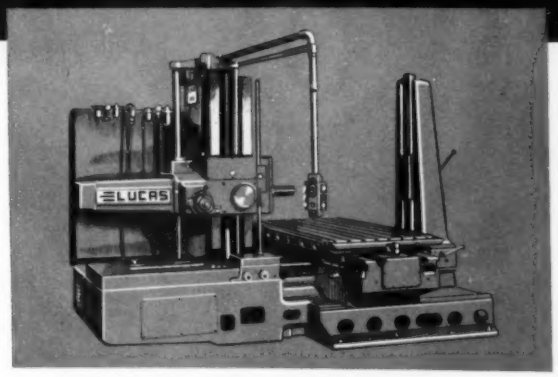
ANGULAR MILLING

DRILLING

REAMING

TAPPING

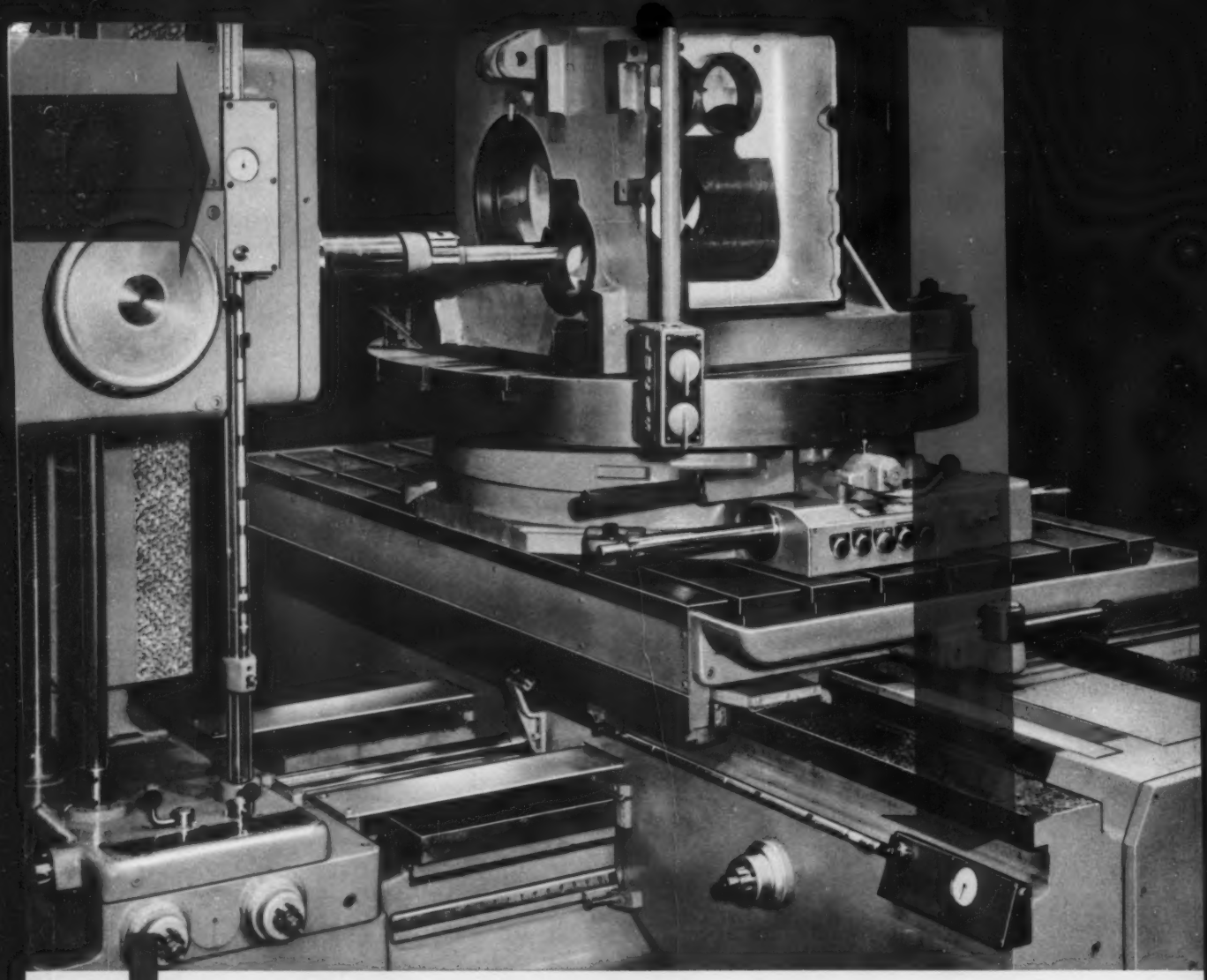
THREADING



Automatic power positioning with Lucas precision

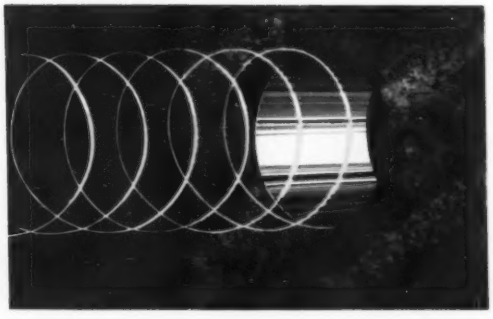
For production or faster completion of a single piece: locates head and table to predetermined settings for boring operations. No time wasted on jigs or fixtures in drilling, reaming and tapping. Lucas versatility, precision and time saving are the keys to Lucas profitability. Lucas Machine Division, The New Britain Machine Company, Cleveland, Ohio.

LUCAS
OF CLEVELAND



Automatic repeat settings accurate to ±.0001

Lucas Automatic Power Positioning operates at rapid traverse to locate head and table, entirely independent of operating feed rates—thru a system of end measuring rods and micrometer dial indicators. Upon starting the positioning cycle the machine does the precision setting automatically. Would you like a complete Lucas Catalog? Lucas Machine Division, The New Britain Machine Company, Cleveland, Ohio.



LUCAS
OF CLEVELAND

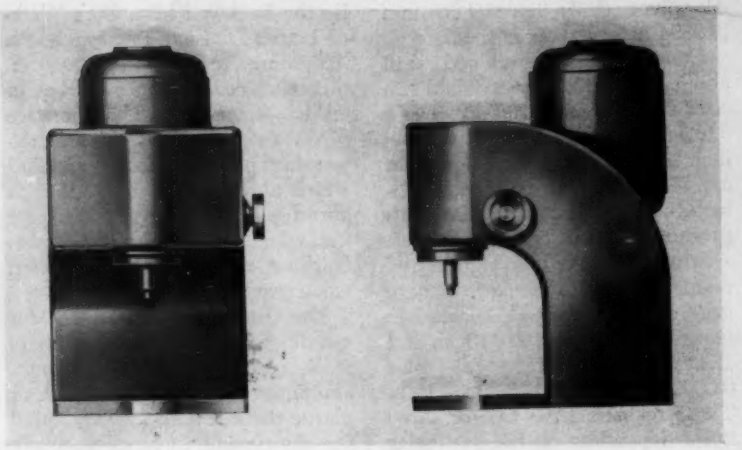
(New Shop Equipment continued from page 194)

Barnes Portable Press

A Barnes E.J.S. portable arbor press especially designed for small assembly work and fabricating jobs has been brought out by the John S. Barnes Corporation, Rockford, Ill. The machine has a pressure range of from 50 to 1500 pounds, requires a space only 10 by 13 inches, has a 4-inch stroke, 1-inch ram, and 5 1/2-inch throat. It weighs 150 pounds and is furnished with a built-in hydraulic power unit and 3/4-hp motor which can be connected to any convenient 110-volt, 60-cycle current outlet.

For high-production applications, it has automatic control features to synchronize with any machine tool or production line. Available with hand-lever, push-button or foot controls for toolroom, laboratory, or low-production use. For unlimited throat depth, the press can be supplied without base but with mounting lugs for secure positioning where desired.

Circle 582 on Readers' Service Card



Portable arbor press for small assembly work announced by John S. Barnes Corporation

Ingersoll-Rand Mechanical Feed Drill

A line of drills equipped with mechanical feeds has been introduced by the Ingersoll-Rand Co., New York City. These drills are designed to produce clean, precisely located holes. The company claims that holes drilled with their tools seldom require reaming. There is no plunging when the drill breaks through, and the constant feed serves to decrease the amount of burr left at the rim of the holes. Even when drilling at angles, holes can be precisely located and misalignment eliminated.

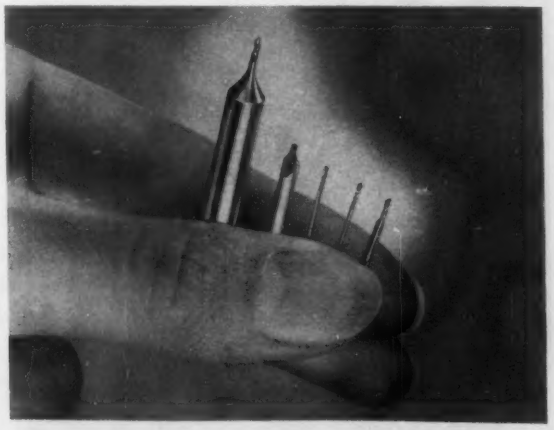
These air-powered drills are said to greatly reduce operator fatigue; have a wide range of feed and speed adjustments. Drills are available with twelve speeds ranging from 450 to 4500 rpm, two power ranges, straight or offset handles, and 0 to 5/16-inch drill chuck capacity. Forward travel and quick return are very simple to adjust (0 to 1 1/4 inches). Feed is engaged by a sturdy jaw type clutch. Five drilling feeds ranging from 0.002 to 0.008 inch per revolution of the drill spindle are also available.

Circle 583 on Readers' Service Card

Miniature Cutting Tools

A line of high-speed steel cutting tools designed to meet demands for miniaturized products has been brought out by the DoALL Co., Des Plaines, Ill. Included in this line are miniature twist, pivot, and center drills, reamers, and end mills. The twist drills are available in sizes of 0.15 mm (0.0059 inch) through 0.50 mm (0.0197 inch) in both right- and left-hand cut. Pivot drill sizes range from 0.10 mm (0.0039 inch) through 0.40 mm (0.0157 inch).

Air-powered drill with mechanical feed announced by Ingersoll-Rand Co.



Midget size high-speed steel cutting tools introduced by the DoALL Co.

All pivot drills have 1.00 mm (0.0394 inch) diameter shanks.

Center drills (combined drill and countersink) are available in sizes 00 and 0. The 00 size has a 0.025-inch drill diameter and 5/64-inch body diameter. The 0 size has a 1/32-inch drill diameter and 1/8-inch body diameter. These tools produce burrless centers.

Straight-shank, straight-fluted reamers are also stocked in wire gage sizes, 61 through 80, and in two fractional sizes, 1/64 inch and 1/32 inch. Tolerance is plus 0.0002 and minus 0.0000 inch. These reamers have two or three flutes depending on the particular size involved. A set of twenty reamers, sizes 61 to 80, comes in a handy metal container.

Miniature end mills are standard in eleven different styles—a total of seventy-seven sizes—ranging from 1/32 inch through 3/16 inch in steps of 1/64 inch. All single-end, double-end, and ball-end tools have 3/16-inch shanks. They are ground from the solid and have radial backoff.

Circle 584 on Readers' Service Card

Abrasive Belt and Disc Finishing Machine

A combination belt and disc finishing machine, said to be capable of performing a wide range of operations, has been introduced by the Rockwell Mfg. Co.'s Walker-Turner Division, Pittsburgh, Pa. According to the manufacturer, this machine is useful in shops of all sizes, from the local automotive repair shop, to the largest metal-working plant. It has a standard 4-inch abrasive belt and a 12-inch abrasive disc; it is designed for use where custom or production finishing work must be handled efficiently and economically.

The machine is adapted for grinding, surfacing, or polishing steel components, die castings, aluminum, brass, copper, wood, or plastic parts. It is also well adapted for sharpening tools. A specially designed idler-drum guard facilitates hollow grinding of wood and lathe chisels, carving tools, and plane irons. There are no wheels to dress and quenching in water is not necessary.

The 4 1/4- by 12-inch platen can be inverted for most underside finishing or deburring operations on small, hard-to-handle parts. A removable end-guard permits inside contour-finishing operations on the idler drum, and a 9 3/4- by 16 1/4-inch table furnishes ample work support for finishing large patterns. The fully machined disc is balanced for vibration-free operation, assuring accurate finishing on close-tolerance patternmaking operations.

Another important advantage is no lost motion in operation. The belt and disc combination enables the operator to move from one machine to the other in seconds, as required when finishing curved, straight, or irregular-shaped parts.

Circle 585 on Readers' Service Card

Motor-Driven Speed Lathe

A versatile speed lathe with a piggy-back belted motor drive is being produced by the Standard Electrical Tool Co., Cincinnati, Ohio. This compactly arranged versatile unit has a spindle speed range of from 180 to 3600 rpm. Selection can be made for only one speed with a wide range of two-speed and four-speed combinations.

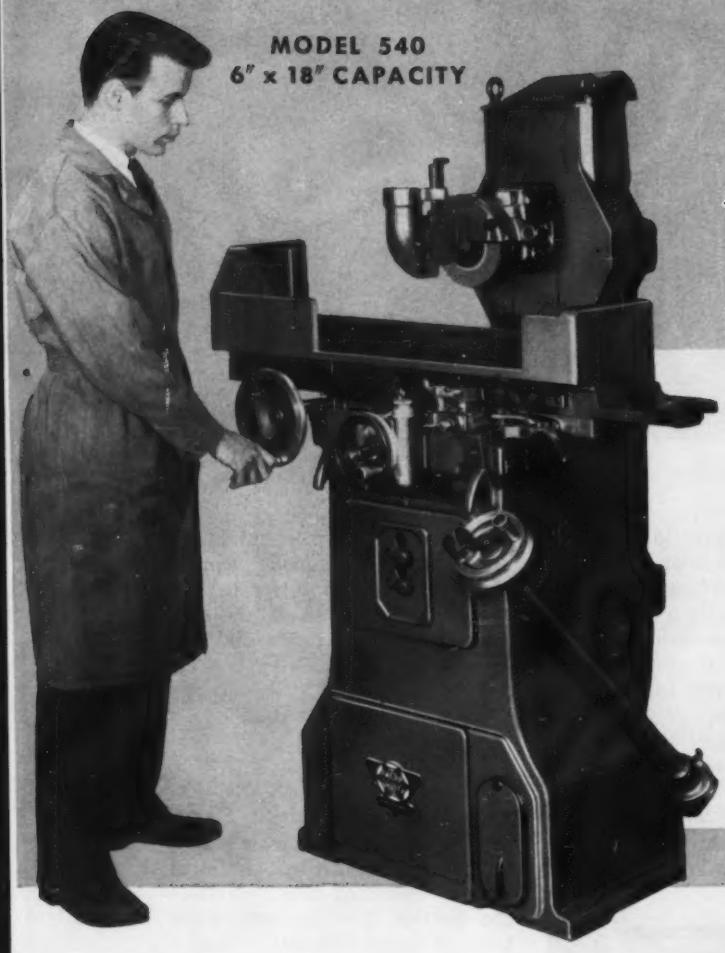
The lathe delivers continuous heavy-duty service on secondary operations, such as polishing, burnishing, lapping, spinning, reaming, deburring, and filing of small parts.

The heavy-duty work-spindle is ball-bearing and permanently lubricated. There is a 1-inch diameter through-hole in the shaft. The spindle nose accommodates No. 5C draw-in collets up to 1 inch in diameter round, 7/8-inch hexagonal, and 3/4-inch square. Hand-lever control provides simultaneous opening/closing of the collet, closing/opening of the motor circuit with instant applying/releas-

Walker-Turner abrasive belt and disc finishing machine

Speed lathe unit produced by Standard Electrical Tool Co.

HYDRAULIC SURFACE GRINDER



MICRO MATIC
HONE CORPORATION DETROIT MICHIGAN
MANUFACTURED BY
JONES-SHIPMAN
LEICESTER, ENGLAND

ACCURACY... EFFICIENCY... EASE OF OPERATION

This machine has all the essential qualities required to provide high caliber surface grinding. Its simplicity of design provides ease of operation while inherent accuracy and efficiency assure excellent grinding performance. Thousands of these grinders have been purchased by discerning users in every part of the world.

FEATURES:

- Completely centralized controls within easy reach of operator.
- Patented low-pressure, long-life Hydraulic System operating from self-contained motor-driven pump unit.
- Table traverse rates variable from 5′ to 40′ per minute. Smooth and shockless reversing at maximum speeds.
- Cross-feed automatically variable from .01 in. to .07 in. per stroke.
- Hand controls provided for both traverse and cross-feed. Micrometer adjustment to cross-feed in .0001 in. divisions.
- Vertical adjustment of wheelhead controlled by conveniently placed handwheel having a micrometer knob adjustment in .0001 in. divisions.
- Wheelhead slide operates on ball bearing rollers running on precision ground bars providing absolute sensitivity of vertical feed.

Automatic vertical wheelhead feed and electric lift can be fitted to standard machine as an extra feature. Also, numerous other attachments including form tool grinding equipment are available to assure full versatility.

FOR FURTHER INFORMATION, WRITE FOR YOUR COPY OF BULLETIN C183.

PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC

MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

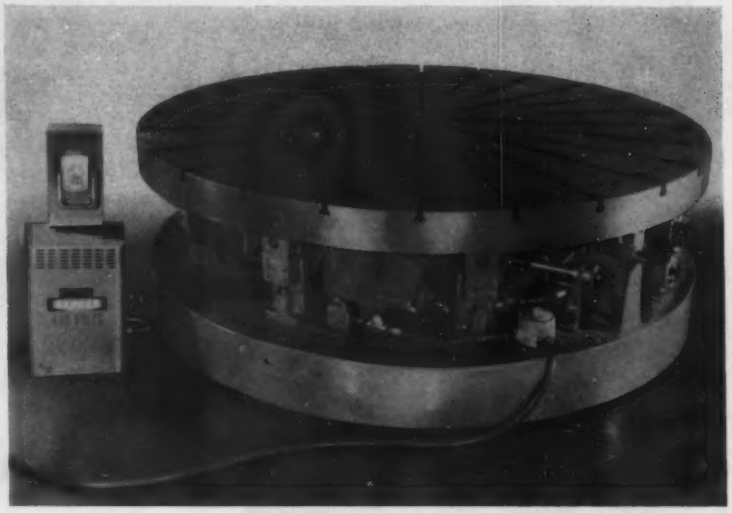
ing of the brake. Partial travel of the hand-lever permits manual rotation for inspection of the work. When required, the control can be arranged so that a slight hand-lever movement will open the collet while the motor continues to operate.

Circle 586 on Readers' Service Card

Large-Size Precision Rotary Table

Perhaps one of the largest precision horizontal rotary tables ever built has just been completed by the Machine Products Corporation, Detroit, Mich. The table is 102 inches in diameter and has a bearing-load capacity of 90,000 pounds. In spite of its size, this table features an accuracy of 5 seconds of an arc, certified by autocollimator reading. Preliminary rotation positioning is achieved by a visible counter reading from 0 to 359 degrees. Final positioning is done manually with the aid of a microscope which provides minute-and-second adjustment to permit zeroing-in on a precision-graduated band. Positioning within 5 seconds of arc is easily attainable.

Additionable features of the new table include: adjusting-speed motor drive from zero to 1/3 rpm (108 inches per minute); high capacity cone-worm gearing with positive backlash controls and de-energized self-locking brake. The platen and spindle assembly are supported by a precision "X" type roller bearing plus auxiliary outer antifriction bearing supports. To facilitate setup procedure the face-plate is provided with suitable T-slots plus machined annular grooves at 2-inch intervals. The horizontal rotary table is designed primarily for inspection and machining operations. Other sizes are available.



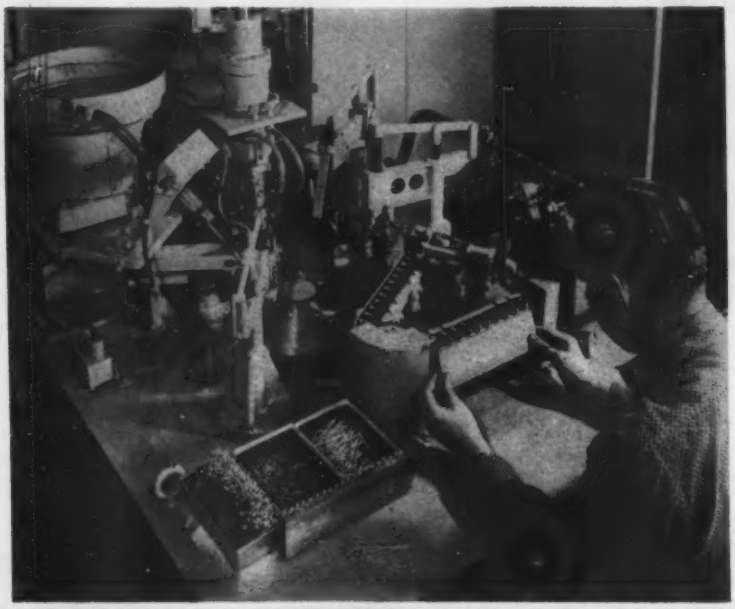
King-size precision rotary table built by Machine Products Corporation

Circle 587 on Readers' Service Card

Automated Transistor Welder

An automated welder that can assemble and weld 1850 transistor cases an hour has been introduced by the Precision Welder & Flexo-press Corporation, Cincinnati, Ohio. Mounted atop a 5-foot square table, and centered about the variable speed indexing turn-table of the welder are six manufacturing stations. In loading, the operator inserts transistor bases (headers), ten at a time, in a moving chain. A fixture removes each base from the chain, gathers the wire leads, and inserts the assembly in an electrode on which the base rests. Next, a cap delivered from a hopper is automatically assembled on the base. A photo-electric sensing station checks the mounting of the cap, stopping the machine in case of malfunction. A precision 10-kva C-frame welding unit, with air diaphragm follow-up, welds the cap to the base. Finally, the mechanical lift ejects the finished welded assemblies to a chute.

Transistor base and cap are of gold-plated steel. The weld must be gas-tight and must be made in a controlled atmosphere. The table top provides a leak-proof base for



Precision automated transistor welder with atmosphere dry box removed

4-col. presses bristle with

KRW has done it again! This time, the 25-1000 ton KRW line of 4-column, single action hydraulic presses has been modernized to set a new pace over a broad work range.

Bristling with newness, these smooth-acting machines are built to outperform even KRW's highly regarded, prior designs in a wide variety of assignments: Blanking, forming, punching, trimming, drawing, extruding, briquetting, straightening, pressure clamping, laminating and bonding.

Already acclaimed "a marked success," KRW's latest version of the 4-column press boasts numerous features to improve quality and increase productivity: Of rugged, welded steel construction, the crown, bed and sliding platen provide maximum resistance to deflection. Align-bored to automatically controlled tolerances, the sliding platen is guided on ground and polished columns which are closely fitted into the crown and bed.

Easy to adjust, KRW hydraulic systems assure instant, complete press control. Compactly designed, the pumping unit can be mounted at the top of the press or furnished for floor installation.

Available with either up-acting or down-acting platens, KRW 4-Column Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling.

For detailed information and specifications, write for Bulletin 95-D. K. R. Wilson, Inc., 217 Main St., Arcade, N. Y.

KRW HYDRAULIC PRESSES

a dry box which will cover the machine for controlled-atmosphere assembly. Transformer and turntable drive are mounted below the table. A separate cabinet houses the welding controls.

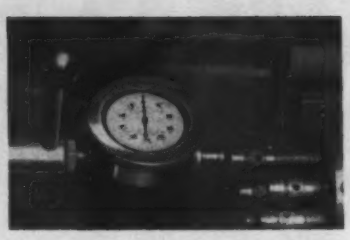
Circle 588 on Readers' Service Card

Electrically Operated Heavy-Duty Punch Press

The Whitney Metal Tool Co., Rockford, Ill., has developed an electrically operated heavy-duty power punch press with a 40-ton capacity and a 36-inch throat depth. The throat is 12 inches high and its depth is completely usable. Features include a solenoid-operated, pin type nonrepeat clutch easily converted to the repeat type. An electric foot-actuated button frees the operator's hands to guide material to be punched.

The electric motor is available for 220-240 or 550-volt, 60-cycle current operation. The press operates at a speed of eighty-four strokes per minute. The hole in the ram accepts punch and die sets with 2-inch shanks. Smaller punch shanks can be employed by using bushings or adapters.

Circle 589 on Readers' Service Card



Roby carriage stop for turret lathe

Stop for Turret Lathe Carriage

The Roby Machine Works, Truro, Iowa, announces a precision turret lathe carriage stop. This patented stop will position the turret lathe carriage to very close limits for all longitudinal operations. It eliminates guessing as to how hard to press the carriage against fixed stops, and materially reduces setup time. Where precision is not required, the solid fixed stops and kickoff can be used with no chance of damage to the indicator by overtravel.

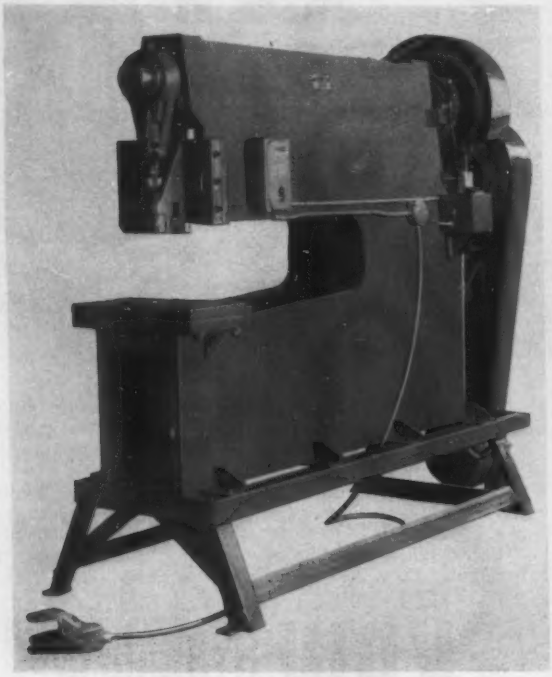
Installation is quick and easy. Simply unscrew stop-rod anvil, screw in stop mounting stud, and tighten lock-nut. The stop is supplied with a mounting stud.

Circle 590 on Readers' Service Card

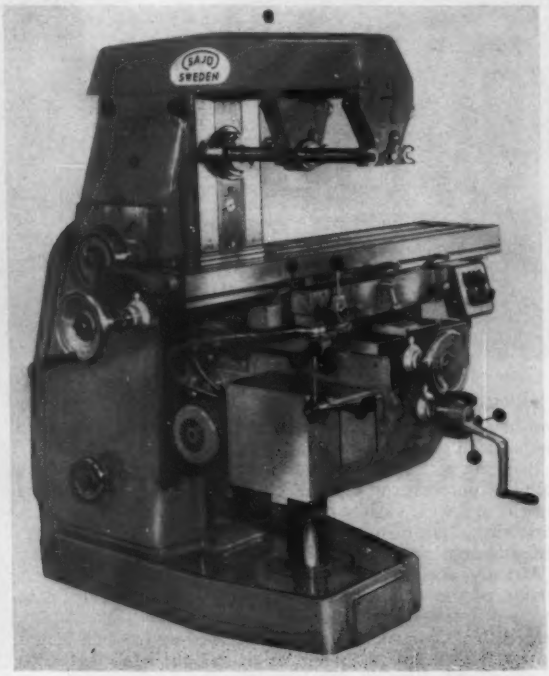
Automatic Production Milling Machine

An automatic-cycling milling machine, designed for saving time and labor on production operations, has been added to the SAJO (Swedish) line of knee type horizontal and vertical models, introduced in this country by the Austin Industrial Corporation, White Plains, N. Y. The No. 2 production miller, Model 54, offers a selection of automatic table cycles ranging from conventional one-way milling with rapid return to skip-feed milling and continuous two-way milling with rapid traverse between cuts, with or without spindle braking.

Because the machine is fully automatic, the operator has only to load and unload the work. Using relatively simple tooling, even unskilled operators can easily tend two or more machines. Change-over from one automatic table cycle to another is made from the operator's position in a matter of minutes, making the machine efficient and economical on both small and medium lots as well as on long production runs. The automatic cycling arrangement

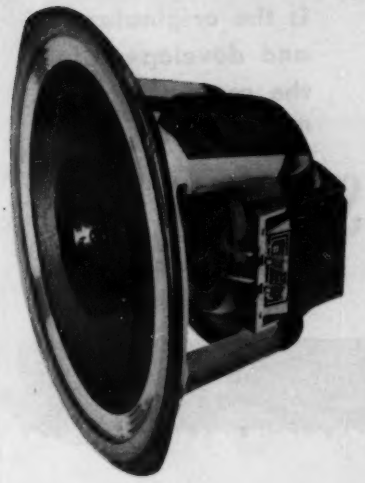


Whitney electrically operated heavy-duty punch press



SAJO automatic-cycling production milling machine

IT'S LIGHTER THAN YOU THINK!



IMPROVES ACOUSTICS and CUTS ASSEMBLY COSTS WHEN DIE CAST with ZAMAK

This zinc die cast "basket" for the UNIVERSITY Model 312 Diffaxial 3-way High-Fidelity Speaker provides the improved design and production economies necessary for outstanding performance characteristics and moderate price of this newly designed speaker, made by University Loudspeakers, Inc.

Formerly an assembly of steel stampings, this one-piece design contains supports, flanges, slots, ribs, holes, studs and channels for permanent centering and mounting of the cone, magnet pot assembly and other components. Expensive spinning and other machining operations are eliminated and final speaker assembly requires fewer steps, resulting in significant production economies.

First prize winner in our "Lighter Than You Think" die casting contest, this frame weighs only 2 lbs. 12 oz. and measures 13" across corners. It is 4⅝" deep and has a minimum wall thickness of .040". The thin-wall, hollow struts are designed to offer minimum sound reflecting surfaces while providing the extreme rigidity required for mechanical stability of the entire structure. There is no loss of magnetic energy in this speaker since zinc is non-magnetic.

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY

THE NEW JERSEY ZINC COMPANY

DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY

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HORSE HEAD PRODUCTS ®

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HARTFORD 2, CONN.

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can easily be disengaged for conventional operator-controlled milling when desired.

Unique SAJO spindle construction employing SKF special precision-grade bearings is said to ensure smooth transmission of full motor horsepower to the cutter. Dial selection regulates speed and feed. Outside adjustment is provided for the backlash eliminator. The automatic-cycling feature is available on either Model 54 plain horizontal miller, or on Model 54 vertical miller. Table size is 52 by 11 inches. Longitudinal power feed is 33 1/2 inches. The main-drive motor is of 7 1/2 hp and the table-feed and rapid-traverse motor, 1 1/2 hp.

Circle 591 on Readers' Service Card

Improved 14-inch drill press developed by South Bend Lathe, Inc.

Improved Drill Press

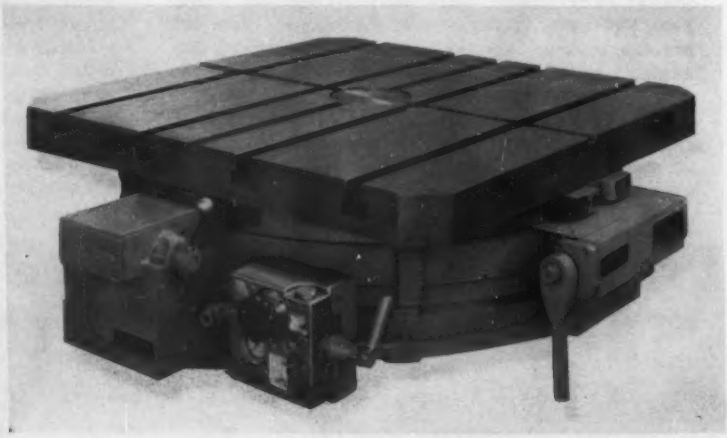
A 14-inch drill press of improved design has been developed by South Bend Lathe, Inc., South Bend, Ind. This machine is available in bench, floor, and multiple-spindle production models. It has a capacity for drilling 1/2-inch holes in iron or steel to the center of a 14 1/2-inch circle. Four spindle speeds, ranging from 720 to 4325 rpm, are available with 1725-rpm motor. A 1140-rpm motor gives a speed range from 480 to 2885 rpm. Maximum spindle travel is 4 inches. The table has a work surface 10 by 10 inches and can be tilted to any angle. A motor of 1/3 or 1/2 hp is recommended.

Features include: built-in light, rack type depth gage, free-floating spindle, adjustable quill-return spring, and four precision ball bearings. Interchangeable spindles are available which can take No. 2 Morse taper shank tools, 1/2-inch straight shank tools, or router bits and shaper cutters.

Circle 592 on Readers' Service Card

"Airmist" Rotary Tables for Indexing Heavy Off-Center Loads

A line of "Airmist" rotary tables designed to index extra-heavy off-center loads has been announced by the Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio. When these tables are indexing, an air-oil mist lifts the top by specially designed valves in the way surface of the base. This, in effect, floats the top on about 0.001 inch of



Cincinnati Gilbert Airmist rotary table

mist. An exclusive feature (patents applied for) of these tables is that the lift is automatically distributed so that an offset load is always supported. The air-oil mist cannot spill out on the unloaded side of the table. In addition, the air-oil mist is said to prevent corrosion from the moisture of the lifting air. Airmist tables can be used with horizontal boring mills and milling planers. If desired, they can be furnished on runways for use with floor type horizontal boring mills.

They're available, round or square, in a broad range of standard sizes starting at 36 inches. Special sizes may be ordered.

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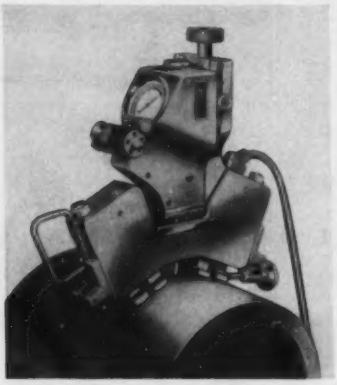

Portable Penetrascope introduced by Steel City Testing Machines, Inc.

Portable Hardness Tester

Hardness testing of parts in places that are usually inaccessible is easily accomplished now with the "Penetrascope"—available from Steel City Testing Machines, Inc., Detroit, Mich. Vickers hardness numbers of parts having either curved or flat surfaces can be obtained because Penetrascope is held by an electromagnetic clamp having four pole pieces, two adjustable to accommodate different degrees of curvature of the work. Tests can be made in grooves with a minimum width of 2 inches and to a depth of 7 inches. Standard loads up to 30 kg are manually applied by a hydraulic unit. The indentor is a standard 136-degree pyramid-shaped diamond. Hardness ranges from 150 to 1100 dph (Diamond Pyramid Hardness, or Vickers) are within the capacity of this tester. A 3 1/2-inch objective

ALLEN

Allenpoint's deep, full-circle bite assures tremendous resistance to removal torque! Stays tighter longer!

When you need a set screw that you can depend on to stay tight under heavy strain and vibrations, specify ALLENPOINT. Here's why you can always depend on ALLENPOINT: proper design of the cup diameter results in a rugged grip that makes the full-circle pattern you see here . . . deep, strong, clean sockets allow full wrenching leverage . . . and uniform Class 3A threads assure a tight friction lock over the entire length of Allenpoint Set Screws.

Ask your ALLEN Distributor for samples and full engineering details—he's always ready, willing, and able to give you prompt, practical service!

50 ANNIVERSARY YEAR ALLEN HEAD 1910-1960

ALLEN MANUFACTURING COMPANY

HARTFORD 1, CONNECTICUT, U.S.A.

"THIS LUBRICANT EXTENDED BEARING LIFE 50%"

—says REPUBLIC AVIATION CORP.
Makers of the famous F-84E THUNDERJET

"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

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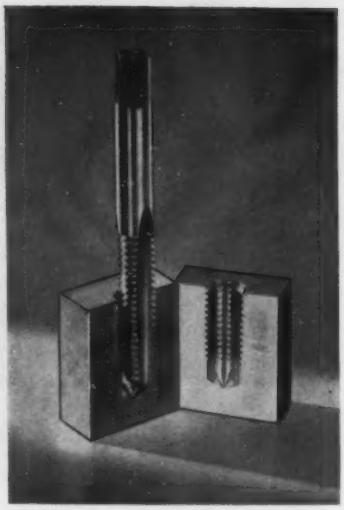
and an indentor fitted to a sliding turret, remote controlled from the body of the instrument to facilitate testing in awkward or inaccessible places, are regular equipment. Measurement of the impression is made by means of an optical indicating micrometer with an accuracy of plus or minus 0.001 mm.

The standard model operates on 110/240-volt and 40/60-cycle alternating current. A chain clamp can be used with this tester for obtaining the hardness of nonferrous parts.

Circle 594 on Readers' Service Card

Jarvis Cold-Forming Tap

A fluted cold-forming tap is announced by the Jarvis Corporation Tap Subsidiary, North Attleboro, Mass. This tap introduces an entirely new concept in cold-forming chipless tapping. Designated "Jar-Flo FT" (fluted type), it forms threads without chips. Prior to this, cold-forming taps were fluteless and required more than ordinary torque to drive them. By fluting the new tap (the flutes do no cutting) contact area has been reduced, thereby lessening drag and reducing the driving torque. The fluting provides for effective lubrication, allowing the lubricant to move directly to the forming area. The increased lubrication is said to lengthen tap life and provide smoother threads. It also allows the same tapping equipment used for standard taps of equivalent size to be employed.



Jarvis cold-forming tap

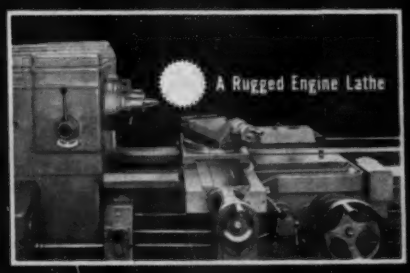
Circle 595 on Readers' Service Card

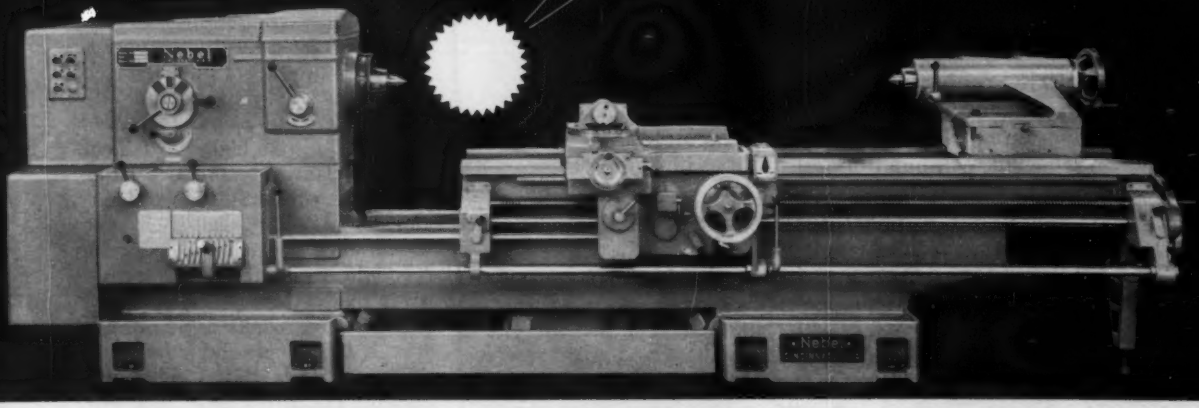
"Roto-Trimmer" for Cutting Risers from Castings

A "Roto-Trimmer" modular cutting unit for fast, accurate cutting of risers from foundry castings has been designed by Wallace Supplies Mfg. Co., Chicago, Ill. The chuck of this trimmer, which holds the casting, rotates as the abrasive wheel cuts. This lessens the arc of contact, keeping the work cooler

Wallace Roto-Trimmer modular cutting unit

DOUBLE PURPOSE





NēBEL

HEAVY DUTY
EXTENSION BED GAP LATHE

Now Nebel brings to the heavy duty field the unique benefits of the extension bed gap lathe. The new, proven design, Model HXB 26/45 provides 26½" diameter swing over the upper bed, 46" diameter swing through the gap and 48" to 84" adjustable centers in base length. Built to complete A.S.A. standards for engine lathes it's truly heavy duty in every component part and in turning capacity.

And, significantly, Nebel, with its established economy offers the HXB 26/45 at a price competitive to standard engine lathes. In effect you get 2 heavy duty lathes for the price of one, thereby reducing your capital investment. *Write for new descriptive Bulletin No. 211*

NēBEL LATHE DIVISION, NEBEL MACHINE TOOL CORPORATION
3410 Central Parkway, Cincinnati 25, Ohio Lathe Builders Since 1899

SEE US AT BOOTH 1319, DONOVAN HALL, AMPHITHEATER, CHICAGO, 1960 MACHINE TOOL EXPOSITION, SEPT. 6—16. MMT-PE

FACING ... *another problem*

SPOT FACING operation at Monarch Rubber Company, Hartville, Ohio. These Osborn End Brushes—in combination with drills—are horizontally mounted in two drill clusters. They clean surplus rubber from bolt holes and face the area around bolt holes on both sides of this rubber-bonded-to-steel motor mount. Rate: 750 pieces per hour.

SOLVED *with Osborn power brushing*

Facing off surplus rubber inside and around the bolt holes of this shock-absorbing, rubber-bonded-to-steel motor mount used to be a production bottleneck for this manufacturer.

Now an efficient combination setup of drills and Osborn Power Brushes replaces a former slow, costly drill press operation. Production is up to 6,000 pieces per 8-hour shift with brush life running 18,000 to 20,000 parts.

Your own troublesome metal finishing problems of every description—deburring, cleaning, polishing, precision blending—can be eliminated with advanced Osborn power brushing methods. An **O**sborn **B**rushing **A**nalysis—made in your plant now at no cost or obligation—is the first step toward smoother, less costly production. Write for details. *The Osborn Manufacturing Company, Dept. D-59, Cleveland 14, Ohio.*

Osborn Brushes

OSBORN®

Metal Finishing Machines . . . and Finishing Methods
Power, Paint and Maintenance Brushes
Foundry Production Machinery

For more data circle this page number on card at back of book

and the cut more accurate. Wheel life is also lengthened. The chuck has a capacity for holding 9-inch outside diameter by 1/2-inch wall stainless-steel rings or 6-inch solids; cuts off the risers with 0.031-inch maximum corner radii of the cut-off surface.

Separate starting switches for drives on the rotator chuck and cutting spindle are provided. A 16-inch abrasive cutoff wheel is used with a 10-hp, 220/440-volt, three-phase, 60-cycle motor with a variable speed rotator. Roto-Trimmer is 60 11/16 inches wide, by 55 inches deep.

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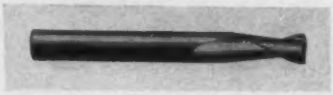


Fig. 1. Two-flute, single-end Thriftmill

Fig. 2. Two-flute, double-end Thriftmill

Two-Flute Thriftmills

After more than a year of rugged shop testing, the Brown & Sharpe Mfg. Co., Providence, R. I., has added two-flute, single- and double-end Thriftmills to its line of four-flute Thriftmills. Thriftmills are made exclusively by Brown & Sharpe, a product of their research and engineering departments. The mills are ground from solid, metallurgically tested high-speed steel and are claimed to produce faster and more efficiently than conventional end mills. Also, their cost is said to be as much as 20 per cent less, which puts them in a throw-away tool class.

The new two-flute Thriftmill, Fig. 1, is a single-end type, with 30-degree helical flutes, right-hand cutting. The shank is same diameter as the cutter for greater tool rigidity and longer life. The two-flute double-end Thriftmill, Fig. 2, is recommended for most conventional end-milling operations, and is well suited for profiling, peripheral milling, and general end-milling work. Both types available from stock in six sizes: 1/8, 3/16, 1/4, 5/16, 3/8 and 1/2 inch.

Circle 597 on Readers' Service Card

Precision Boring Quills

Precision boring quills that allow infinite adjustments in controlling the size of bored holes without loosening or tightening screws are now made by the Briney Mfg. Co., Pontiac, Mich. The new quills can also handle an integrally operated depth-control adjustment when required. This new design, Fig. 1, permits the user to split tenths (adjust smaller than 0.0001 inch) to compensate for tool wear on ultrafine-tolerance boring jobs. Simple adjustments are made with a hex-key.

These boring quills operate on the patented Briney Principle which utilizes ball bearings in an eccentric mounting within the boring quill to provide tool adjustment. Formerly, Briney boring quills could only be adjusted by turning the calibrated bearing bushing with a spanner wrench.

The new quills eliminate the need for two bearings, permitting the quill bodies to be made smaller. This is an important factor when part and fixture clearances are critical. Adjustment on the new quills is done by a small

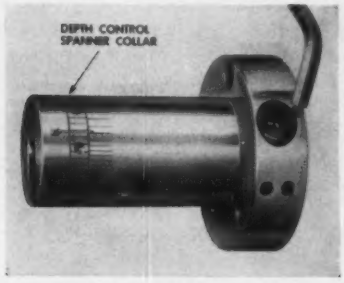


Fig. 1. Precision boring quill designed and made by Briney Mfg. Co.

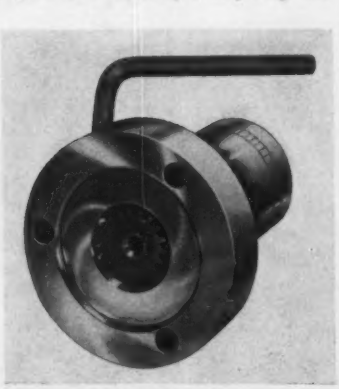
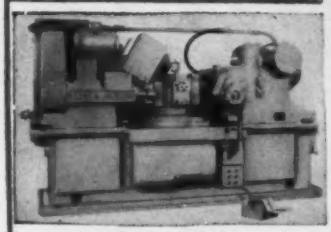


Fig. 2. Worm-gear drive mechanism of boring quill shown in Fig. 1

Single set-up covering
ALL finishing operations...
MEANS
GREATER ACCURACY
with
GOSS DeLEEUW



AUTOMATIC
CHUCKING
MACHINES

One of the many important advantages being realized with this new chucker is the performing of ALL finishing operations on a single chucking of the work. In addition to the time saved, this feature, exclusive with Goss & DeLeeuw "1-2-3" machines, means only one handling of the work with an attendant greater accuracy. This machine is in a class by itself in precision finishing.

In Goss & DeLeeuw "1-2-3" Automatic Chucking Machines, one, two, or three ends of the work are machined simultaneously or in sequence. There is no need for resetting, retooling or secondary operations. More work from one machine and greater accuracy are matters of record.

Ask for illustrated literature describing the operation of this chucker in detail. Send samples of your work for time and cost estimates.

MMT=PE
Booth No. 348

GOSS & DeLEEUW

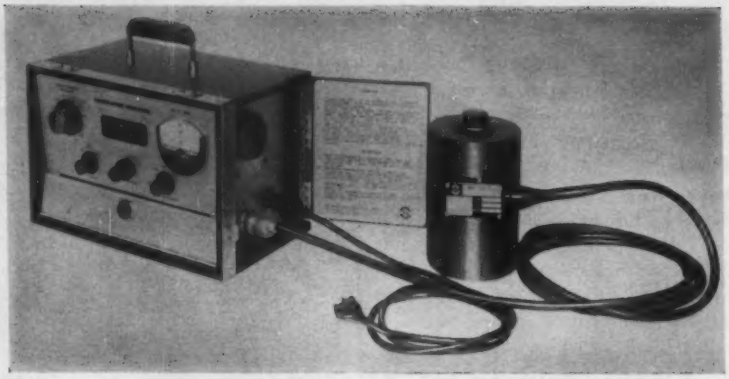
GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

For more data circle this page number on card at back of book

worm-gear drive, Fig. 2, located in the quill's mounting flange. This drive is engaged with the boring-bar or bar holder. A positive drive to the boring-bar is provided by the worm-gear hookup.

As in all Briney boring quills, there is no backlash or slippage—important features when precision hole diameters must be maintained. Briney's "infinite size-control" precision boring quills are available to fit all standard boring spindles.

Circle 598 on Readers' Service Card



B-L-H's SR-4 portable force calibration and checking kit

Kit for Checking Force Measuring Systems

A portable, lightweight kit for calibrating and checking force measuring systems with laboratory precision—even in field use—has been introduced by the Electronics and Instrumentation Division of Baldwin-Lima-Hamilton Corporation, Waltham, Mass. This kit provides a convenient unit for checking and calibrating tension and/or compression loads output in weighing systems, jet engine test stands, missile thrust stands, and similar applications. It contains a precision calibration indicator featuring quick digital readout plus a high-accuracy calibration load cell. Combined, these units guarantee direct-reading accuracies of a high order.

Using available standard cells, the capacity range is from 60 to 120,000 pounds for tension, and from 60 to 240,000 pounds for compression service. This is possible because of a special calibration model of the manufacturer's SR-4 load cell as the sensing element. The load cell acts as a load transducer, converting load changes into electrical values. A complete range of standard cells or cells for specific applications can be supplied with the kit.

A transistorized precision calibration indicator is a null-balanced instrument capable of alternating- or direct-current operation. A built-in standardizer allows a calibration check without applying a known load to the calibration load cell.

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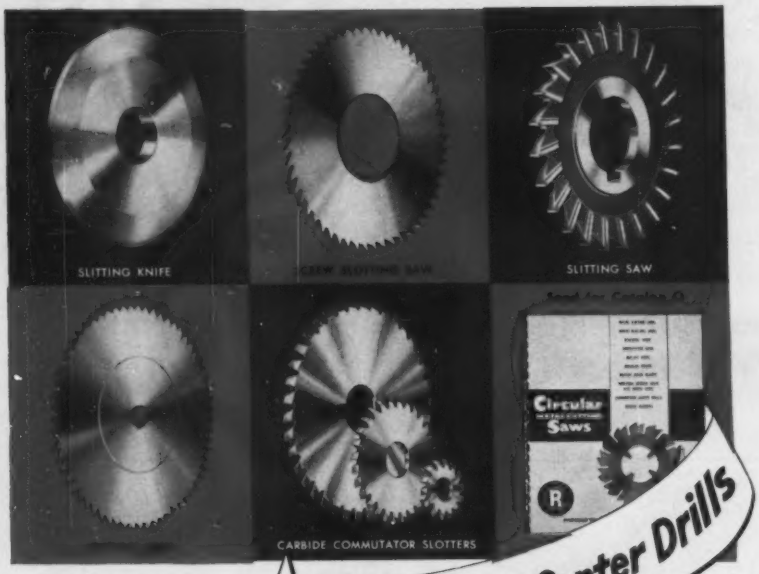
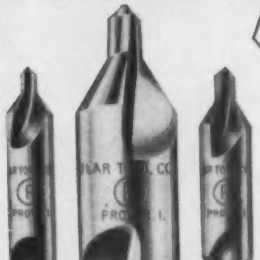
From More Than 1200 ® Catalog Items...



Combination Center Drills

403-9



CIRCLE R center drills include "all three"—hi-spirals, old standard letter drills, new standard number drills—in regular, arbor or bell type from smallest to 1" sizes. Perfected by unique heat treating. Order from our catalog of 1200-plus items.

Consult a CIRCLE R *Specialist in . . .*

BURBANK · CHICAGO · CLEVELAND · DAYTON · DETROIT · HACKENSACK · INDIANAPOLIS · MEMPHIS · MILWAUKEE · MONTREAL · NEW HYDE PARK · NEW YORK CITY · PHILADELPHIA · PHOENIX · PITTSBURGH · PROVIDENCE · ROCHESTER

CIRCULAR TOOL CO., INC.

PROVIDENCE 5, RHODE ISLAND

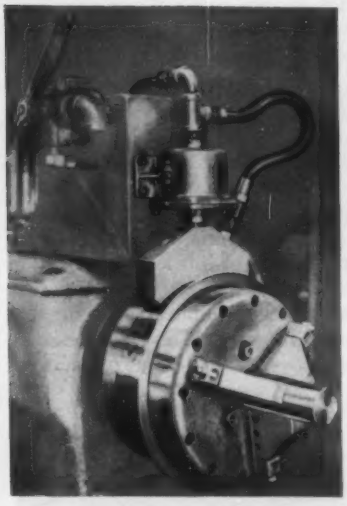
Specialists in Circular Cutting Tools Since 1923

METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

Kit of Assorted Dowel Pins

Dowel-pin assortment kit, specially designed to eliminate time-consuming trips to the stock room for dowel pins. Dowels are contained ducto Machine Co., Bridgeport, Conn. The kit contains ten each of the sixteen most-used sizes of dowel pins. Dowels are contained in separate compartments for easy selection, with a lift-out tray revealing the bottom section. A diagram in the box lid shows the location of each size. Refills are available from all Producto distributors.

Circle 600 on Readers' Service Card



Retractable Air Coupling for Power Chucks

Retractable air coupling with self-contained air cylinder for power chucks with through-feed spindles announced by the N. A. Woodworth Co., Detroit, Mich. This device can be used with either automatically cycled or manually controlled bar-feed machines. It also facilitates the machining of shaft-like parts that project into the spindle. In operation, an air-actuated shoe contacts the periphery of the chuck adapter plate when the air valve is turned on. Regardless of where the chuck stops, the shoe will be over one of a series of special valves incorporated in the adapter plate. After the part is in chucking position the air is turned off and the shoe retracts. Use of the retractable air coupling eliminates the manually operated snap coupling or power wrench and reduces cycle time for load and unload stages. The unique valve system incorporated in the adapter plate permits the interchanging of various types of air-operated devices without disturbing the control setup. The present model of the retractable air coupling is applicable to devices operated on horizontal spindles only.

Circle 601 on Readers' Service Card

(This section continued on page 224)

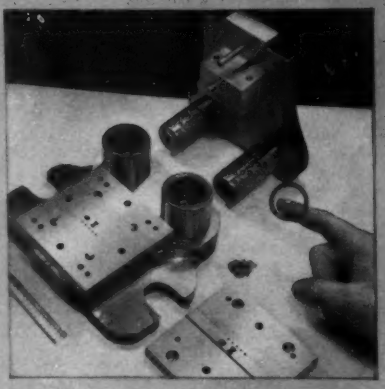
NOBODY SAID *"It Couldn't Be Done"*

BUT ONLY LEMPCO 2 POST STOCK* DIE SETS COULD DO IT!

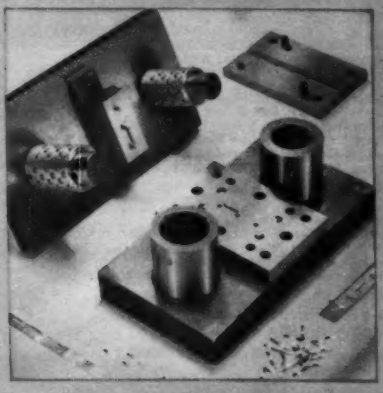
To the best of our knowledge, Lempco is the only 2-post STOCK* die set which could produce this electronics part from .001" thick high nickel alloy material—with punched holes of .001" diameter. This die, mounted in a standard Lempco STOCK* die set, produced 30,000 burr-free parts on its initial run.

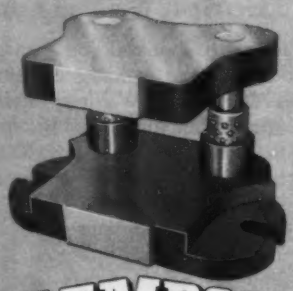
Users everywhere have found that a STOCK* Lempco 2-post die set will out-produce special 4-post "friction type" sets—at a fraction of the cost. You can prove this to yourself!

*Off-the-shelf DELIVERY, with warehouse stocks in all major metalworking areas of the U.S.A.



MATERIAL: .001" Thick, High Nickel Alloy
Punched Holes, .001" Diameter





WRITE OR PHONE US TODAY
FOR FURTHER INFORMATION.

Diebuilder: Vamco Machine & Tool, Pittsburgh

LEMPCO INDUSTRIAL, INC.

DUNHAM RD. · BEDFORD, OHIO

Tel. MOntrose 2-2400 — Cleveland Exchange

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Moline Malleable Iron Co., St. Charles
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Link-Belt Company, Indianapolis 6
National Mall. & Steel Castings Co., Indianapolis 22

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MASSACHUSETTS
Belcher Malleable Iron Co., Easton

MICHIGAN
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Auto Specialties Mfg. Co., Saint Joseph
Cadillac Malleable Iron Co., Cadillac
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MISSISSIPPI
Mississippi Malleable Iron Co., Meridian

NEW HAMPSHIRE
Laconia Malleable Iron Co., Laconia

NEW YORK
Acme Steel & Mall. Iron Works, Buffalo 7
Frazer & Jones Company Division Eastern Malleable Iron Co., Solvay
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Central Fdry. Div., Gen. Motors, Defiance
Dayton Mall. Iron Co., Ironton Div., Ironton
Dayton Mall. Iron Co., Ohio Mall. Div., Columbus 16
Maumee Malleable Castings Co., Toledo 5
National Mall. and Steel Castings Co., Cleveland 6

PENNSYLVANIA
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Erie Malleable Iron Co., Erie
Lancaster Malleable Castings Co., Lancaster
Lehigh Foundries Company, Easton
Meadville Malleable Iron Co., Meadville
Pennsylvania Malleable Iron Corp., Lancaster

TEXAS
Texas Foundries, Inc., Lufkin

WEST VIRGINIA
West Virginia Mall. Iron Co., Point Pleasant

WISCONSIN
Belle City Malleable Iron Co., Racine
Chain Belt Company, Milwaukee 1
Federal Malleable Company, Inc., West Allis 14
Kirsh Foundry Inc., Beaver Dam
Lakeside Malleable Castings Co., Racine
Milwaukee Malleable & Grey Iron Works, Milwaukee 46

These companies are members of the Malleable Castings Council

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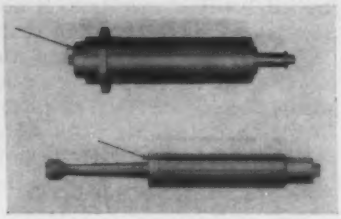


Pope Grinding Spindles

The Pope Machinery Corporation, Haverhill, Mass., has announced the development of an improved, concealed, axial air-flow flinger for its internal grinding spindles. This flinger successfully prevents coolant from entering the spindle bearings at points indicated by arrows in the illustration. It also provides complete protection for the operator from rotating end covers. These precision spindles are built so that the total eccentricity of the shaft, measuring in the tapered hole, will not exceed twenty millionths of an inch (0.000020 inch). They are dynamically balanced with all rotating parts in full assembly to twenty-five millionths inch (0.000025 inch) amplitude of vibration.

Circle 602 on Readers' Service Card

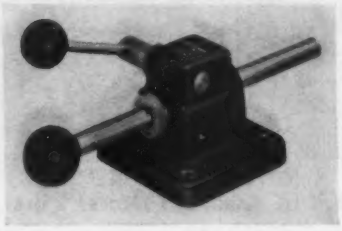
Aro Spot-Welding Gun

King size spot-welding gun now added to the welding equipment line of Aro Spot Welders, Division, Guthery Machine Tool Corporation, Long Island City, N. Y. Designated Aro Model 510, this spot welder provides up to 18,000 amperes and a pressure of 1350 pounds. It is air-operated, fully automatic, water-cooled, and can weld from the lightest gage up to 2- by 3/16-inch material. The welder is equipped with gyroscopic suspension for easy rotation in all directions.

Circle 603 on Readers' Service Card

Adjustable Pressure "Jig-Lok"

"Adjusto-Quick Jig-Lok," recently developed by L-W Chuck Co., Toledo, Ohio, to simplify jig and fixture design and eliminate special locking details. It incorporates the



same automatic pressure control used exclusively on L-W Adjusto-Quick vises. Simple turning of the control automatically adjusts the holding pressure from 1 up to 1500 pounds. Light hand pressure locks and securely holds the rigid or non-rigid work in position without distortion. The Jig-Lok is made in two models, with base dimensions 4 by 4 or 5 by 5 inches.

Circle 604 on Readers' Service Card

Air Lube Gear-Spray Valve

Gear-spray valve for centralized lubricating systems announced by Trabon Engineering Corporation, Solon, Ohio. This valve requires only 15 to 25 pounds of air pressure for optimum spray results and automatically shuts off air when lubricant feed is cut off. This results in substantial savings in air and lubricant. No adjustment of spring tension to meet varying conditions of lubricant viscosity or temperature is required. Oils and all greases suitable for pumping may be used. The valve can be employed with centralized systems

(Continued on page 227)

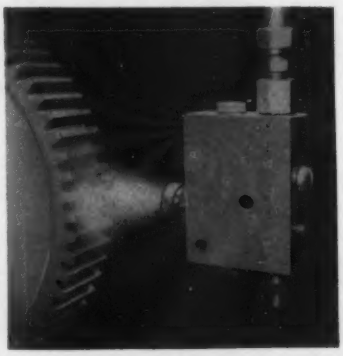


Photo-elastic stress patterns produced by models photographed with polarized light are one of the modern analytic tools available for ever-increasing perfection of Malleable iron castings.

For Greatest Strength Per Dollar... Use Malleable

To improve quality and cut costs, you'll find nothing better than Malleable iron castings. They provide more strength per dollar than any other metal, ferrous or non-ferrous! With Malleable you also get proven toughness, uniform quality and unsurpassed machinability.

See for yourself how much Malleable castings will improve your products and cut your costs. Send drawings or an outline of your requirements to a nearby Malleable castings producer who displays this symbol—

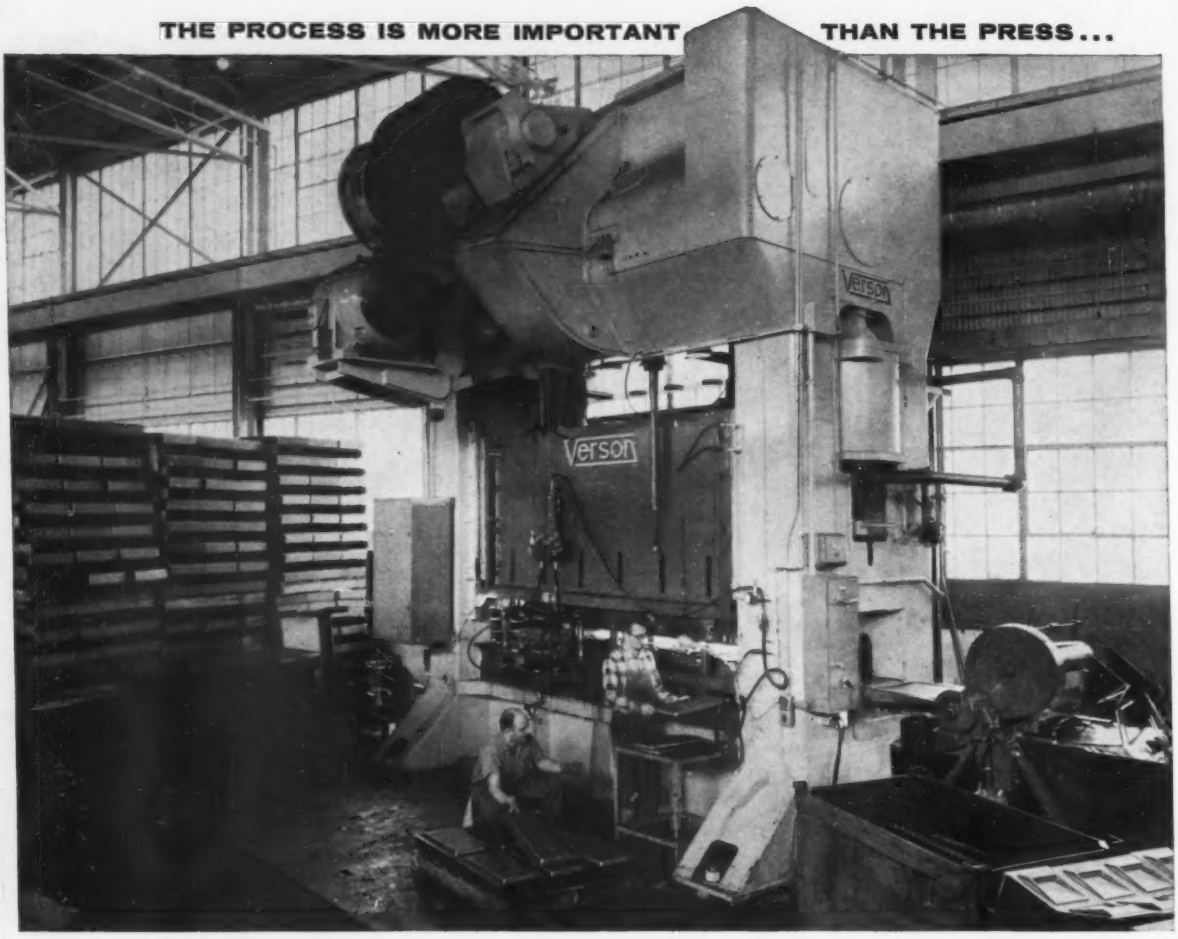
MEMBER

MALLEABLE

CASTINGS COUNCIL

For detailed information on "Strength Characteristics of Malleable Iron Castings", contact any of the progressive companies listed on the opposite page, or Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

THE PROCESS IS MORE IMPORTANT THAN THE PRESS...



"Verson" engineered progressive die tool-up produces two sizes of electrical enclosures and covers for Federal Pacific Electric Company

The most important fact about any press is what it can be made to do. This Verson 1000 ton eccentric press produces *two* sizes of electrical enclosures and covers with the *same* tooling at 20 strokes per minute.

The press is installed in one of the Newark, N. J., plants of Federal Pacific Electric Company, a progressive, fast-growing manufacturer of products for the distribution and control of electricity.

Two sets of progressive die tooling are employed. One set can be adjusted without removal from the press to produce two sizes of panel enclosures (11¼" x 24" and 13½" x 24"). The other set can be adjusted to produce covers for both sizes of enclosures. Five operations are performed on the enclosures, seven on the covers.

When you are looking for ways to improve the efficiency of your production processes, discuss your stamping requirements with a Verson engineer. He'll show you the difference in specifying a process rather than just a press. Call or write, today, for prompt attention to your needs.

237

Originators and pioneers of allsteel stamping press construction

VERSON ALLSTEEL PRESS CO.

-Verson-

9309 S. Kenwood Avenue, Chicago 19, Illinois • 8300 S. Central Expressway, Dallas, Texas

MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES
TRANSMAT PRESSES • IMPACT MACHINING PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS

For more data circle this page number on card at back of book

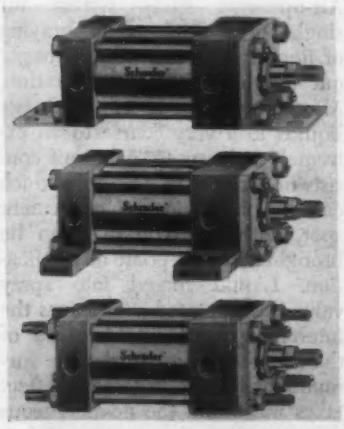
(Continued from page 224)

that are specifically planned for gear lubrication only, or it can be added to existing systems where a switch to "all-purpose" lubricant permits both gears and bearings to be served by the same pump. In the latter case another valve, injector, or feeder is added to the existing system to supply lubricant to the gear-spray valve.

Circle 605 on Readers' Service Card

Schrader Double-Acting Air Cylinders

Square-end, double-acting air cylinders introduced by A. Schrader's Son, Division of Scovill Mfg. Co., Brooklyn, N. Y., now available with three new mounts: angle bracket (top), side leg (center), and extended tie-rod (bottom). This brings the number of interchangeable mountings to eight, making large inventories of specialized cylinders unnecessary. The broad choice of mountings makes the JIC cylinders easily adaptable for wide ranges of holding, positioning, or moving operations. The basic cylinder is available in five sizes up to a 4-inch bore; built for air pressures up to 250 psi, or hydraulic pressures up to 750 psi. Design features include: cartridge type bronze bearing with self-adjusting U-cup piston rod seal; ground, hard chromium-plated



piston rods with a minimum yield strength of 125,000 psi; machined cylinder ends and mounting plates; and high-strength tie-rods with 87,000 to 107,000 psi yield point.

Circle 606 on Readers' Service Card

(Continued on page 228)

MARVEL
SYNCLINAL FILTERS

FOR DEPENDABLE PROTECTION on all Hydraulic and other low pressure circulating systems

Designed to give more ACTIVE filtering area—MORE dependable protection—MORE productive operation before cleaning is necessary. *Meet J.I.C. Standards.*

A

A—Synclinal SUMP TYPE
CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not available.

B—Synclinal LINE TYPE
CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
BY-PASS VALVE: Not available.
OPERATING PRESSURES: Up to 80 p.s.i.

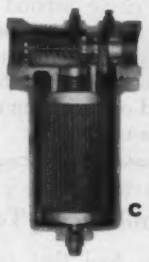
B

C—Bonded LINE TYPE
CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1¼"—1½"—2" and 2½".
BY-PASS VALVE: Available with or without.
OPERATING PRESSURE: Up to 250 p.s.i.
OPERATING TEMPERATURES up to 300° F.

D—IN-LINE FILTER
CAPACITIES: Up to 60 G.P.M.
PIPE SIZES: ¾"—1"—1¼" and 1½" (at both inlet and outlet).
BY-PASS VALVE: Available with or without.

E—Bonded SUMP TYPE
CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1½"—1¼"—2" and 2½".
CONNECTIONS: Coupling—"O" Ring—Male Nipple.
BY-PASS VALVE: Available with or without.

F—Tandem SUMP TYPE
CAPACITIES: 10—16—20—40—60—100—150 and 200 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not available.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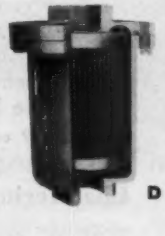
D

E

F

FILTERING MEDIA in all Marvel Filters is Monel wire cloth available in mesh sizes of 30-40-50-60-80-100-150 and 200 to meet your filtration requirement.
EASY TO CLEAN—All Marvel Filters are easy to clean. Line type units operate in any position and may be serviced without disturbing pipe connections.
OVER 900 O. E. M's. install Marvel Filters as Standard Equipment.

IMMEDIATE DELIVERY

For further information on a specific type filter—Write—wire or phone

MARVEL ENGINEERING COMPANY
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Phone: JUniper 8-6023

Please send me information on Marvel Filters as indicated: (MY-7)

☐ Hydraulic Oils ☐ Coolants ☐ Lubricants ☐ Fire Resistant Fluids
☐ Water ☐ Sump Type ☐ Line Type ☐ In-Line

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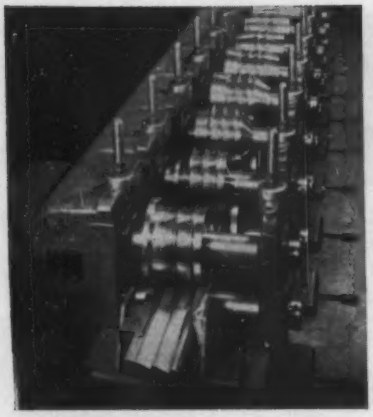


Yoder Roll-Forming Equipment mass-produces shapes accurately, economically

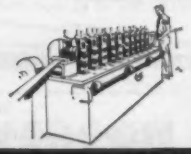
Yoder Roll-Forming Equipment, even with part-time operation, can effect significant savings in many metal working applications and industries. Shapes, simple or complex, can be quickly and economically produced the Yoder way from a wide variety of flat-rolled coated or uncoated stock ... in thickness up to ¾ inch ... in speeds up to 50,000 feet per day.

Yoder engineers flexibility and precision into metal forming operations. For example: many basic shape modifications, such as coiling, welding, notching, ring-forming, perforating, and cutting to length can be simultaneously accomplished with little or no additional labor cost.

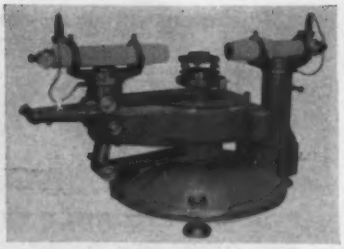
Yoder also makes a complete line of Rotary Slitters and Pipe and Tube Mills. Profit from Yoder's years of engineering and service experience, contact your local Yoder representative or send for the Yoder Roll-Forming Manual.

This fully-illustrated 88-page book clearly discusses every important aspect of Yoder Roll-Forming Equipment and methods ... it's yours for the asking!

THE YODER COMPANY
5504 Walworth Avenue • Cleveland 1, Ohio



YODER COLD ROLL FORMING MACHINES



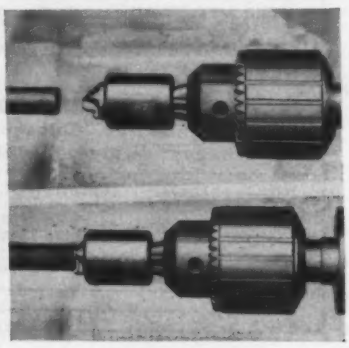
Goniometer for Precise Angle Testing

Microptic precision goniometer for calibration of divided circles, polygons, and angle gages that provides direct reading to 0.1 second of arc is available from Engis Equipment Co., Division of Engineering and Scientific Instrumentation, Chicago, Ill. This instrument was developed from the famous Watts Guild high-precision spectrometer and adapted with specially improved optics for precise angle testing. The bearing for the work-table carries a glass divided circle; the auto-collimating telescope unit contains an optical system for determining the mean value of the opposite-side circle readings. Thus, the measurement of the auto-collimator rotation and table rotation may be obtained separately with equal precision. The table can be rotated relative to the divided circle around an auxiliary center by a micrometer spindle engaging a worm-wheel. A second auto-collimating telescope is mounted on a column carried by the base casting.

Circle 607 on Readers' Service Card

Chamfering and Facing Tool

"TuBurr" cutting tool that combines three operations in one for finishing tube ends in screw machines, multiple-spindle machines, and tube-finishing machines. Made by Cogsdill Tool Products, Inc., Oak Park, Mich., this tool will perform outside- and inside-diameter chamfering and facing operations all in one stroke. Spindle travel toward the tube automatically centers the cone-shaped tip in the tube end, thus eliminating any misalignment. Continued spindle travel retracts the cone into the tool body, exposing the blade for cutting. Upon release of spindle pressure, the cone returns to its original position, out over the blade. Blades are interchangeable and available for any angle or degree of chamfer. Capacities of standard models range up to 2 1/2-inch inside-diameter tubing.

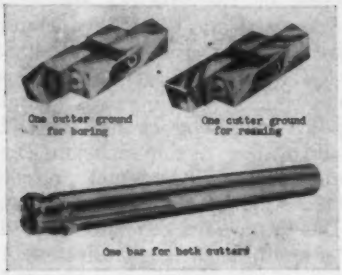


Circle 608 on Readers' Service Card

Spray-rite System for Cooling and Lubricating Cutting Tools

Air-operated spray system for single- or multiple-point spraying of liquids from any angle brought out by the Oil-Rite Corporation, Manitowoc, Wis. It will discharge liquids in a very coarse to an extremely light spray. The unit consists of a reservoir assembly which can be placed in any convenient spot, with a nozzle that can be brought close to point of application. Liquid forced into spray valve is evaporated as it leaves the internal spray nozzle because of the high-velocity air stream surrounding it. A refrigeration effect takes place and the advantageous cool spray can be used for lubricating and cooling cutting tools on turning, milling, grinding, tapping, reaming, sawing, and punch press operations. The spray is also used for lubricating gears, cams, high-temperature chains, etc.

Circle 609 on Readers' Service Card



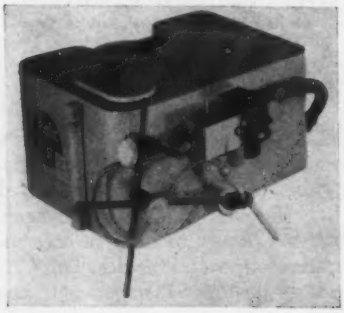
Boring and Reaming Tool Kit

Tool kit designed to save time and tool inventory on limited short-run boring and reaming operations announced by Muskegon Tool Industries, Inc., Muskegon, Mich. The kit utilizes one bar and two adjustable cutters for a given boring and reaming operation. One cutter is ground for boring and can be replaced by the second cutter, which is ground for reaming without disturbing the bar setup. Since the cutters are fully adjustable, the user can machine a wide range of diameters with minimum tool inventory as well as reduce setup time. For holes from 5/8 to 1 inch in diameter, the kit provides one standard slot bar and two standard cutters, one for boring and one for reaming. For holes 1 inch and larger, one heavy-duty slot bar and two heavy-duty cutters are provided.

Circle 610 on Readers' Service Card

Mist Generator with Automatic Control

Model D-60 Mistic mist-coolant generator made by Aetna Mfg. Co., Bensenville, Ill., for use on drill presses having 2 3/4-inch columns. Air and coolant are controlled automatically by the up and downward movement of the drill press spindle. The attach-



ACCURACY
ACCURACY
ACCURACY

. . . to millionths of an inch

Accuracy that's a must for tool rooms . . . so fine it can be measured only by a light bounce, so precise it produces micro-inch finishes at production speeds. This is the accuracy you get in the No. 560 Grand Rapids Precision Tool Room Type Hydraulic Feed Surface Grinder . . . accuracy assured by such features as hand-scraped V-shaped ways, rigid one-piece column and base casting, truly automatic cross feed and extra-heavy spindle. Why settle for less?

For information on the No. 560 or the Nos. 550, 360 and 350 Tool Room Type Surface Grinders, send a note on your letterhead.

GALLMEYER & LIVINGSTON

Booth 751
The Machine Tool Exposition

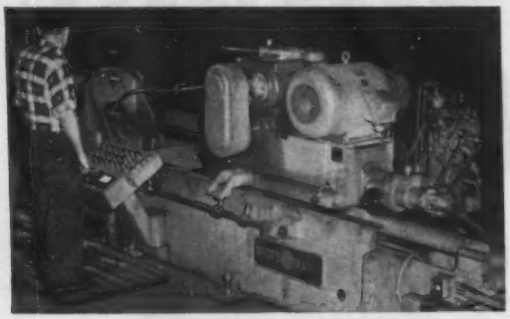
MMT-PE

GALLMEYER & LIVINGSTON CO.
305 Straight Ave., S.W. Grand Rapids, Michigan

For more data circle this page number on card at back of book

WHY MICROHONING* OF HARDENED LINERS cuts production time two-thirds

One of the largest steel corporations utilizes Microhoning's rapid stock-removal in the processing of oil well slush pump liners. Bore diameters ranging from 4.50″ to 7.75″ and up to 28″ long are lined with a special alloy steel hardened to 64-66 Rockwell "C". Over one cubic inch of stock per minute is removed from bores of these liners to reduce required production time by two-thirds.



This heavy-duty Hydrohoner has a 4-foot hydraulic head stroke, an 8-speed transmission, a special heavy-duty feed mechanism and automatic stonewear compensation.

One heavy-duty horizontal Hydrohoner has eliminated the use of bore grinding (two grinders), and replaced two old vertical honing machines. Requiring only one operator, the Hydrohoner does the complete bore machining operation in one-third the previous time. Also, during the automatic rough-Microhoning cycle, the operator is free for an average of 20 minutes to work on an adjacent machine, where the liner O.D. is machined concentric to the Microhoned bore.

Two Microhoning operations are performed (rough and finish) to provide final bore roundness and straightness within .0005″ and surface finish of 6-8 microinches (rms). An extremely hard surface having geometric accuracy and controlled finish lasts longer, provides better performance – that's why Microhoning is specified for processing these oil well slush pump liners.

Shown are rough-Microhoned and finish-Microhoned bores. Following each Microhoning operation every bore is given a close inspection under the revealing probe of a fluorescent light to insure a flawless surface.

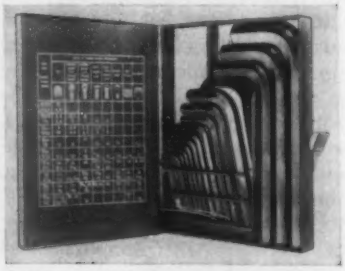
See facing page for details on how Microhoning of pump liner bores secured production time savings.

**Registered U.S. Pat. Off.*

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

ment of the tank to the drill column permits complete operator freedom and greater press work capacity. In addition to the On-Off control, needle valves permit precision setting of the air and coolant flow to suit each job. The exclusive universal-joint nozzle holder permits easy nozzle setting. The Mistic Mist generator is used for multiple-machine production or general shop work. Its regulated control of efficient mist cooling on drill press operations is said to greatly increase production output and lengthen lives of tools used for tapping, drilling, reaming, and similar operations.

Circle 611 on Readers' Service Card



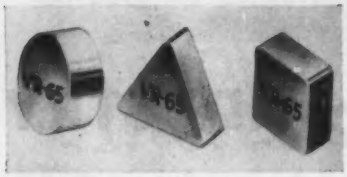
Hex-Socket Screw Key Kit

Key kit that holds hex-socket screw keys in a wide range of sizes to fit all except the largest diameter Allen hex-socket screws, made by Allen Mfg. Co., Hartford, Conn. This No. 667 key kit holds eighteen hex keys in a compact, sturdy metal box measuring only 5 3/4 by 7 1/2 inches by 3/4 inch. Keys range from the smallest (0.028 inch) through 5/8-inch hex diameter sizes, and fit all hex-socket screws in that category. The kit also includes new 7/64- and 9/64-inch sizes for No. 6 and No. 8 "60" series cap-screws. The inside cover of the box has a key-fit table that shows at a glance the correct key size for each socket-screw product. A rack inside the metal box tilts keys outward for quick selection.

Circle 612 on Readers' Service Card

Vascoloy-Ramet Cemented Titanium Carbide

Inserts made from the first of a series of VR-65 cutting tool materials created and manufactured by Vascoloy-Ramet, Waukegan, Ill., to extend the range of conventional cemented carbides. This VR-65 grade operates between the



speed and feed ranges of today's grades of carbide and ceramic materials. VR-65 is a cemented titanium carbide with other metallic carbides used as alloying ingredients. It is fabricated by powder metallurgy in the same manner as conventional carbides. The material can be brazed to steel shanks and is ground by the conventional methods used for present-day carbides. Nominal hardness of 92.1 Rockwell A is within the range of today's harder carbide grades and the strength of 175,000 psi is in the range of finishing grades.

Circle 613 on Readers' Service Card

Tension Pins

Pressure-fitting tension pins, designed for faster and lower cost pinning applications available from John Gillen Co., Cicero, Ill. These hollow tension pins have a longitudinal slot; are 40 per cent lighter than solid pins; and are made from special highly elastic spring steel, cold-rolled, hardened, and tempered. Outside diameters are predetermined larger sizes than the holes to be fitted. The pin compresses as it is driven into the hole, and the spring steel exerts pressure on the wall of the hole for a secure, vibration-resisting fit. Machined chamfered ends simplify insertion. Gillen tension pins are made in nominal diameters from 1/16 to 1/2 inch and up, and in lengths as specified. Two tension pins can be combined (one inside another) where there is extra-high shear stress or extra-heavy shock load.

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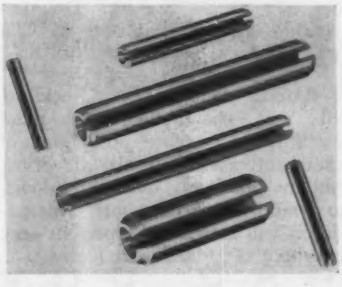
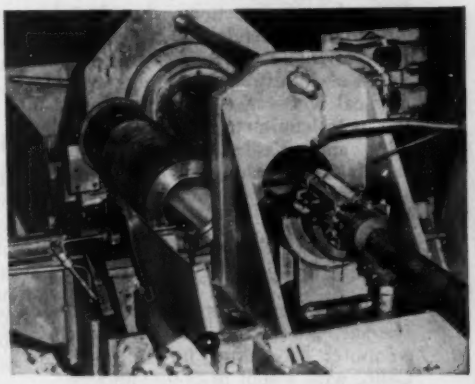


HOW MICROHONING OF HARDENED LINERS cuts production time two-thirds

Microhoning eliminates bore grinding (two grinders), replaces two old vertical honing machines with one horizontal Hydrohoner, and performs all bore machining on this one Hydrohoner in one-third of the previous processing time. Here's how these unusual production results are obtained on oil well slush pump liners.

Two Microhoning operations (rough and finish) are performed on the bores of these hardened (64-66 Rockwell "C") liners. Bore diameters range from 4.50" to 7.75" and lengths are up to 28". The rough Microhoning removes approximately .090" of stock at an average clip of .0045" per minute and generates a 20 microinch (rms) finish.



Fixturing includes hydraulic end clamping to handle liners from 14" to 28" long. Adjustable hydraulic loader handles varying diameters. Heavy-duty Micromold tooling allows the use of more abrasive for faster stock removal. One tool handles a range of bore diameters.

A new stonefeed assembly, capable of exerting a five-ton thrust, permits this stock-removal performance. When the Microhoning tool enters the bore, the abrasives are instantly expanded against the bore surface. As contact is made, a sensing device de-energizes the rapid feed and a pre-set regular feed rate controls further expansion. At the end of the automatically timed Microhoning cycle, the tool is instantly collapsed and withdraws from the bore.

Changeover from rough to finish Microhoning requires only the replacing of abrasives with finer-grit sticks and resetting of timer to shorter cycle—less than 90 seconds is needed for changeover. Finish Microhoning time is about two minutes, roundness and straightness are held within .0005" variation throughout the length of bore, and surface finish of 6-8 microinches (rms) is generated.

MMT-PE

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News OF THE INDUSTRY

California

MICRO-PATH INC., Los Angeles, Calif., totally owned subsidiary of United Industrial Corporation, reports the formation of a new instruments division with the acquisition of manufacturing, sales, and distribution rights to all electronic and chemical devices produced by the ROBERT R. AUSTIN LABORATORIES of San Gabriel, Calif. The Austin laboratories is chiefly engaged in the research, development, and production of a broad line of instruments for gas detection and analysis. Micro-Path intends to expand its new division's operations into the fields of industrial instrumentation, medical electronics, instruments for the petroleum-petrochemical industries, and missile application. Research and development of new instruments will continue at Austin laboratories with all manufacturing and sales activity emanating from Micro-Path.

HUGHES AIRCRAFT CO.'s ground systems group has established a computer laboratory in Fullerton, Calif., with a staff of 600 employes. An outgrowth of several independent project groups, this laboratory has been divided into sections working on land-based and seaborne-computer systems, general-purpose computer systems, and computer-advanced development. Research programs currently under way are missile and satellite tracking in outer space, microminiaturization, and integrated element techniques.

NORTHROP CORPORATION, Beverly Hills, Calif., has purchased 100 per cent of ACME METAL MOLDING Co. stock. It manufactures and distributes architectural aluminum products. Included in the transaction are two Acme marketing and distribution companies—ACME METAL MOULDING CO., LTD. of Canada, and ACME METAL MOLDING CO. of Texas. This purchase marks Northrop's first move into commercial metal products, and is linked to the company's aerospace and electronics continuing program of diversification. The subsidiary will continue operations under its present name and management. Organizationally, it will be operated by Northrop's Norair Division.

GEORGE STRAWN has been appointed Western Region manager for the MECHANICAL DIVISION of General Mills. He will headquarter at the division's office at Redondo Beach, Calif. In his new capacity, Mr. Strawn will be responsible for liaison among General Mills, the Government, and industry in that region.

EDWARD E. SIGG is now vice-president, manufacturing, for the MECHANICAL SPECIALTIES CO., Los Angeles, Calif.

Illinois and Indiana

DONALD W. LANGE has been promoted to the position of sales engineer in the Chicago office (Des Plaines, Ill.) of the PARKER-HANNIFIN CORPORATION. It was also announced that ANCAR ENGINEERING INC., Chicago, Ill., would be a distributor of its Crown compressed-air system components..

VERSON ALLSTEEL PRESS CO., Chicago, Ill., announced the appointments of MELVIN D. VERSON to president and chief operating officer for the company, and JACK A. NOVAK, executive vice-president, to the additional position of secretary. Mr. Verson, with the company since 1950, has served as vice-president, administration, for the past four years.

Melvin D. Verson, president and chief operating officer, Verson Allsteel Press Co.

Jack A. Novak, executive vice-president and secretary, Verson Allsteel Press Co.

DAHLSTROM MACHINE WORKS, INC. of Chicago, Ill., announces the appointments of three new exclusive representatives: BURBANK ASSOCIATES INC., Cincinnati, Ohio; EDWARD A. LYNCH MACHINERY CO., INC., Wynnewood, Pa.; and MIDSOUTH EQUIPMENT CO., INC., Atlanta, Ga.

GISHOLT MACHINE CO., Madison, Wis., has appointed RALPH J. MILLER, JR., district manager of their Chicago territory. Before coming to Chicago he was direct sales representative in the Cleveland territory for eleven years. OLAF M. NYSATHER, a Gisholt direct sales representative in the Houston, Tex., territory since 1956, is now in Chigo to assist in sales.

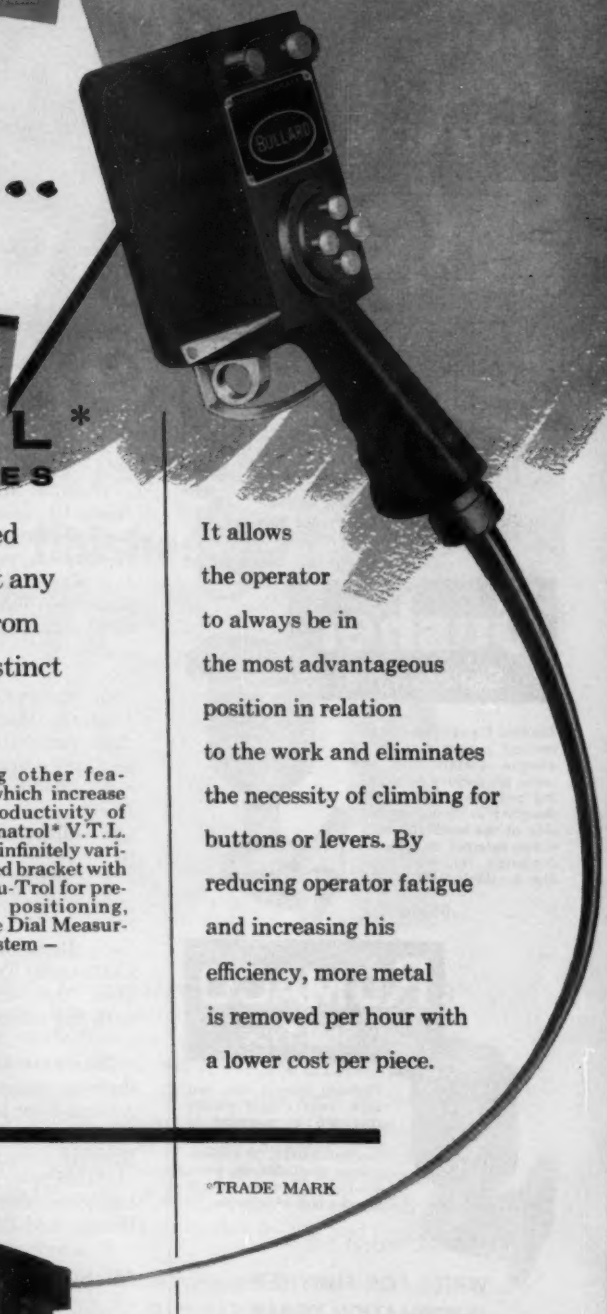
BARBER-COLMAN CO., Rockford, Ill., will expand their Park plant facilities to increase production of their automatic controls, air distribution products, overhead doors, and industrial instruments. This addition will increase the present area by about 170,000 square feet.

FINGER-TIP CONTROL

Increases Productivity of...

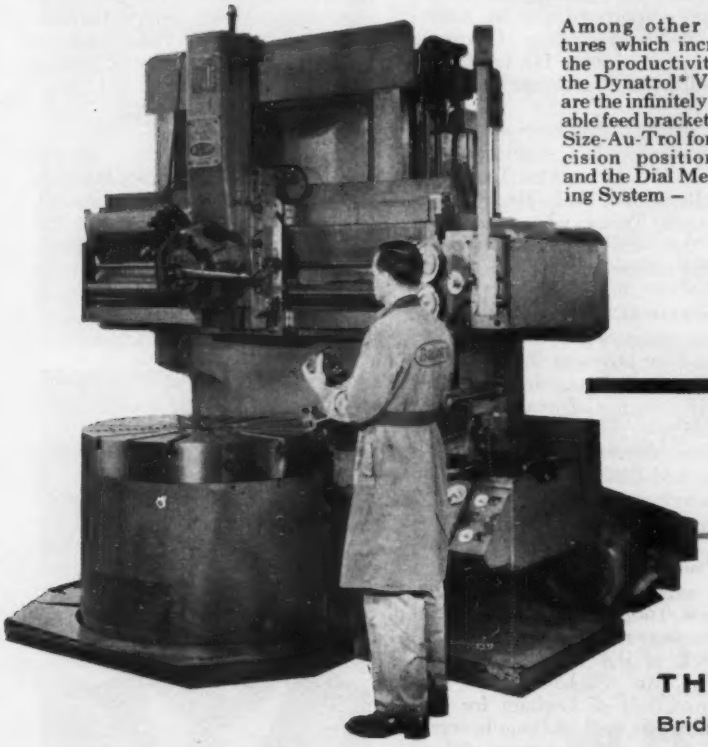
BULLARD

DYNATROL*
VERTICAL TURRET LATHES



Directional control of all head motions in feed on traverse, either horizontally, vertically or at any 45° angle, as well as table start and stop from a lightweight portable pendant, is a distinct production advantage.

It allows the operator to always be in the most advantageous position in relation to the work and eliminates the necessity of climbing for buttons or levers. By reducing operator fatigue and increasing his efficiency, more metal is removed per hour with a lower cost per piece.



Among other features which increase the productivity of the Dynatrol* V.T.L. are the infinitely variable feed bracket with Size-Au-Trol for precision positioning, and the Dial Measuring System –

*TRADE MARK

ask your Bullard Sales Engineer for the complete Dynatrol story or write for catalog.

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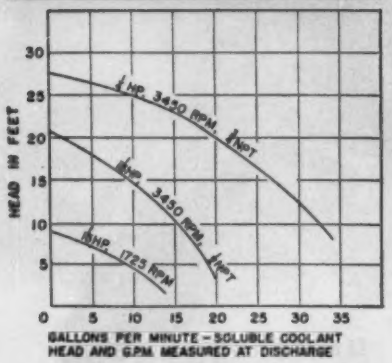
Bridgeport 9, Conn., Telephone EDison 6-2511

YOU CAN'T BEAT A BULLARD

FOR MORE COOLANT PUMP ECONOMY*



*Performance Chart

Gusher
Sealess-Type

Gusher flange mounted coolant pumps feature a simple design with no seals, no packing or priming necessary. They are designed to mount on the side of the reservoirs with either external or internal discharge. Immersed type also available.

Model 5-P

RUMACO
Seal Type

Rumaco pumps are seal type, centrifugal pumps that can be mounted in any convenient place. Precision built, Rumaco pumps give efficient, trouble-free operation. Seals are the best obtainable.

Model 5-S

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• MOLTEN METAL PUMPS

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Circle this page number on card

Charles R. Onsrud, president, Onsrud Machine Works, Inc.

ONSRUD MACHINE WORKS, INC., Niles, Ill., announces the election of the following new officers: CHARLES R. ONSRUD, president; Miss HJORDIS R. KRABOL, vice-president and treasurer; JOHN M. WILKIN, secretary; and O. B. ANDERSON, assistant secretary.

CONTINENTAL SCREW CO., New Bedford, Mass., notified the trade that ARTHUR G. ARISPE will be direct sales representative of northern Illinois (including Chicago), Iowa, and Wisconsin. His headquarters will be in Mundelein, Ill.

CALVIN IRISH has been appointed manager of product engineering of the NATIONAL AUTOMATIC TOOL CO., INC., Richmond, Ind. He replaces LEGRANDE TERRY who is retiring after thirty-five years of service with the company.

WILLIAM L. DRAPER is now industrial products representative for ATKINS SAW DIVISION, Borg-Warner Corporation, Indianapolis, Ind. His territory covers Alabama and coastal Mississippi where he will serve industrial distributors, mill supply houses, and their customers.

Michigan

GEORGE N. POPHAM and his associates announce acquisition of the GORHAM TOOL CO., Detroit, Mich. The transaction involved purchase of all stock in the forty-one-year-old concern. Mr. Popham, who has been president of Gorham for the past five years, will continue to serve as president and treasurer. Other officers are JOHN J. IGLODAN, executive vice-president and secretary, and JAMES L. PRISK, vice-president, manufacturing. All present management, supervisory, and production personnel will be retained intact and the company will continue to manufacture and market its line of standard and special cutting tools through established trade distribution channels.

H. R. KRUEGER & CO., Detroit, Mich., has announced expansion and modernization of plant facilities, and election of new corporate officers as part of a long-range diversification program. The firm is a major supplier of machine tools and automation equipment to the automotive and allied industries. In line with the company's expansion, it is currently establishing additional representation in the field in this country and in Europe. Most recent U. S. appointment is C. E. DRAY of Rockford, Ill., who will handle sales and service of the Krueger line in Illinois, Iowa, and Wisconsin.

ATRAX CO., Newington, Conn., has appointed the MURDOCK TOOL CO., Detroit, Mich., as its distributor in southeastern Michigan. Murdock will carry a complete stock of Atrax solid-carbide burs, end mills, drills, reamers, and routers. It will service customers in Detroit, Dearborn, Ann Arbor, Ypsilanti, Lansing, Wyandotte, Royal Oak, Jackson, Pontiac, Monroe, Mount Clemens, Port Huron, Willow Run, Livonia, and surrounding areas.

GORDON H. CLAYTON, general manager of the Electric Products Division, VICKERS INCORPORATED, Detroit, Michigan, has been elected a vice-president of the company. Mr. Clayton was general manager of the division when he joined Vickers in 1958.

Gordon H. Clayton, vice-president, Vickers Incorporated

ELWOOD HEMLIN was elected vice-president of the R-O MANUFACTURING Co., Madison Heights, Mich.

New England

INDUSTRIAL MACHINERY DIVISION, American Electronics, Inc., Norwood, Mass., has eight new dealers for their "Auto-Cycle" precision boring and turning machines. The new sales representatives are: BRETT MACHINERY Co., Oak Park, Ill., for the Chicago area; FIDELITY MACHINE TOOL Co., Camden, N. J., for the Philadelphia-New Jersey area; GOTTSMAN MACHINERY, INC., Detroit, for the Detroit area; J. M. KALINS Co., Bridgeport, Conn., for that entire state; RICHLIN-WOLF & Co., Great Neck, Long Island, N. Y., for the Metropolitan New York area; INDUSTRIAL SERVICE, INC., Cleveland, for the Cleveland area; GULF MACHINERY SALES, Fort Lauderdale, Fla., for that state; and ZONNE INDUSTRIAL TOOL Co., Los Angeles, Calif., for the southern California area.

Frank J. Kenney, sales manager, Lapointe Machine Tool Co.

FRANK J. KENNEY has been appointed sales manager of the LAPOINTE MACHINE TOOL Co., Hudson, Mass. He has been associated with the company for four years, serving first as salesman in the Detroit area, and more recently as assistant sales manager.

HARRY E. LOCKERY is now manager of engineering for the ELECTRONICS & INSTRUMENTATION DIVISION, Baldwin-Lima-Hamilton Corporation, Waltham, Mass.

HAROLD A. NEFF was elected vice-president and general manager of the HOLO-KROME SCREW CORPO-

4140 and 4150 type Free-Machining Alloy Steels machine better than regular types . . . and cost less in the finished part!

Wheelock, Lovejoy is your best source of 4140 and 4150 type free-machining alloy steels, the easy-working steels that machine far better than regular type steels, and which cost *less* in the finished part.

Wheelock, Lovejoy, for many years the pioneer in the development and application of 4140 and 4150 type free-machining alloy steels, offers you the most extensive stocks anywhere, in all W-L warehouses.

Available variety of 4140/50 type free-machining stock includes round, square, flat, billets, and forgings to specifications.

For best stocks, best service, get in touch with your nearest Wheelock, Lovejoy warehouse.

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AGENTS — Southern Engineering Company, Charlotte, N.C.; Sanderson-Newbould, Ltd., Montreal and Toronto

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STEEL SERVICE CENTER INSTITUTE

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for high quality, long wearing parts at low cost

Here are reasons why you will want to learn more about Shenango solid bars and centrifugally cast tubular bars for quality parts produced on your automatic screw machines or lathes:

- Available centerless ground or as cast
- Lengths up to 6', 1" to 14" diameter
- Choice of analyses—GC Meehanite, GA Meehanite, Ductile Iron, Ni-Resist, Ductile Ni-Resist
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- Machines with a free-cutting chip, not a fine powder
- Special solid bar shapes available ... hexagonal, square, rectangular and oval

Write on your letterhead for a machining sample. Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

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COPPER, TIN, LEAD, ZINC BRONZES • MANGANESE AND ALUMINUM BRONZES
MONEL METAL • NI-RESIST • MEEHANITE® METAL • ALLOY IRONS • DUCTILE IRON

RATION, Hartford, Conn. He's been with the company since its organization in 1929; has been vice-president since 1946, and on the board of directors since 1959.

LAPOINTE MACHINE CO. of Hudson, Mass., has appointed the following U. S. distributors as sales representatives for their complete line of precision machine tools: L. C. KEIR CO., Portland Ore., and Seattle, Wash.; MONTAGUE-HARRIS & CO., San Francisco, Calif.; ART THOMAS MACHINERY CO., Los Angeles, Calif.; NEFF, KOHLBUSH & BISSELL, Chicago and Rock Island, Ill., Indianapolis, Ind., Milwaukee, Wis., and Minneapolis, Minn.; TIPPINS MACHINERY CO., Pittsburgh, Pa.; and JEFFREYS ENGINEERING & EQUIPMENT CO., Greensboro, N. C.

U. N. ALLOY STEEL CORPORATION, South Boston, Mass., has appointed RICHARD L. DUNCAN as product manager of the company's hot work tool-steel division. He will direct metallurgical research and development of new alloys, plus tooling engineering services for the extrusion industry.

Stanley G. Fisher, general sales manager, Fafnir Bearing Co.

FAFNIR BEARING CO., New Britain, Conn., reports the appointment of STANLEY G. FISHER as general sales manager.

DONALD W. CHAMPLIN has been appointed vice-president of engineering and planning, WINCHESTER-WESTERN DIVISION, Olin Mathieson Chemical Corporation, New Haven, Conn. He has been vice-president, manufacturing, for M. W. Kellogg Co., and a vice-president of Canadian Kellogg and T. I. W. Western, Ltd.

WILLARD H. SPENCE was elected vice-president and general manager, Industrial Products Division, BROWN & SHARPE MFG. CO., Providence,

Willard H. Spence, vice-president and general manager, Industrial Products Division, Brown & Sharpe Mfg. Co.

R. I. Mr. Spence will continue as managing director of Brown & Sharpe, Ltd., the company's British manufacturing subsidiary in Plymouth, England, for the present.

COLIN SHARP became director of the research and development laboratory of the CUTTING TOOL DIVISION, Brown & Sharpe Mfg. Co., Providence, R. I. Mr. Sharp will supervise the experimental laboratory, and special cutting tool applications and modifications for customers.

New York and New Jersey

TRUARC RETAINING RINGS DIVISION of Waldes Kohinoor, Inc., Long Island City, N. Y., named two appointments in its sales organization: PAUL E. WOLFE as eastern division manager, a new position in the company; and HEDY ZAWISTOWSKI as manager of distributor and customer services, another new position in the division's expanding sales organization.

MEDELTON CO., INC., manufacturers of coil cradles and stock oilers, gave notice of their move to larger quarters at 262 E. 3rd St., Mount Vernon, N. Y.

BAUSCH & LOMB INCORPORATED, Rochester, N. Y., is the name approved by stockholders to replace the familiar Bausch & Lomb Opti-

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At Eastman Kodak, Warco straight-side presses turn out millions of close-tolerance, high-quality parts for Kodak cameras and motion picture projectors.
Precision, quality and high volume are Kodak watchwords. Federal-Warco plays a vital role in helping Kodak meet its rigid production requirements consistently.
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more economically...more efficiently, with controlled surface finish.

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OA Lengths	4" to 120" with dia. limits	10", 16", 22", 36"	16", 22", 36"
Drivers	Std. or to fit your need	.750" dia. x 2¾" long	1" dia. x 2¾" long
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cal Co. It is recognized that the company is not restricting its research and manufacturing interests to the field of optics alone.

BUFFALO FORGE CO., Buffalo, N. Y., announces the appointment of CHARLES W. LOCKHART as vice-president, sales. He joined the company's engineering department in 1936; was manager of the firm's San Francisco sales district from 1945 until 1953; and most recently, served as sales manager of the Air Handling Division.

Charles W. Lockhart, vice-president, sales, Buffalo Forge Co.

DONALD K. MARSH was appointed general sales manager of GREER HYDRAULICS, INC., Los Angeles, Calif. LEONARD H. SEEMAN was named sales manager of the company's Products Division, Westbury, N. Y.

LEWIS M. DUCKOR has been appointed vice-president of engineering with COLVIN LABORATORIES, INC., East Orange, N. J. He will coordinate all design, development, and engineering functions relative to the company's production of displacement and pressure measurement instruments for industrial, underwater, and aerospace applications.

CHARLES B. PICKERING has been appointed product manager of numerical control systems for the DIEHL MFG. CO., Somerville, N. J., a subsidiary of the Singer Mfg. Co. With Diehl since 1957, he previously was a sales engineer at their Needham, Mass., branch office.

FERRACUTE MACHINE CO., Bridgeton, N. J., has acquired the

complete line of FARQUHAR hydraulic and mechanical presses from the OLIVER CORPORATION.

Ohio

CLEVELAND WORM & GEAR and FARVAL DIVISIONS of the Eaton Manufacturing Co., Cleveland, Ohio, announce the appointment of new engineering sales representatives in Cleveland, Pittsburgh, and Philadelphia to replace the Dingle-Clark Co. which recently announced its retirement from the agency business. The three agencies now representing the two Eaton divisions are being operated by former executives of Dingle-Clark in those cities. The representatives are: in Cleveland, the R. V. ROBISON Co.; in Pittsburgh, the J. P. MURRAY Co.; in Philadelphia, W. M. STILWELL Co.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, has appointed FRANK W. COWDREY as sales engineer in its southern California sales office located in Los Angeles. He will represent the company's industrial pneumatic and hydraulic products including power cylinders, valves, tube and hose fittings, presses, and riveting machines.

LOUIS POLK, JR., has been appointed vice-president of operations of the SHEFFIELD CORPORATION, Dayton, Ohio. He is in charge of research, engineering, manufacturing, and sales of the company's three product divisions—contract manufacturing, machine tools, and instruments and systems. Threadwell Tap & Die Co. of Greenfield, Mass., a subsidiary, and Sheffield's domestic and Canadian service plants are under the direction of Mr. Polk. Formerly he was assistant vice-president and manager of operations.

S. A. CAPPON, manager of the SCREW PRODUCTS DIVISION of the National Acme Co., Cleveland, Ohio, has been elected chairman of the National Screw Machine Products Association, Lake Erie District, for the year 1960-61. He is also chairman of the Committee of Technical Research and Standards of the NSMPA.

CINCINNATI GEAR Co. is building an addition to its modern gear plant located in Mariemont, a Cincinnati suburb. The new two-story structure will add approximately 10,000 square feet of manufacturing and office space to the 60,000 square feet now occupied.

ASSEMBLE PARTS FASTER . . . WITH FEWER REJECTS!

DPS model U power screwdriving machines

- Maintain constant driving torque with new positive control clutch
- Dependable motorized hopper drive with safety clutch protects motor and gears in the event of jamming
- Release screw by body or head with new feed track and escapement mechanism

Write today for DPS Model U Bulletin

You can drive up to 40 screws per minute with a DPS Model U. Nuts are driven equally fast . . . with accuracy that cuts parts waste, improves assembly quality.

DPS offers the Model U in two types: pedestal, and self-contained driving head. Both require minimum space and are readily adaptable to your work flow. Feed track and escapement mechanism mounts on either side of the machine column for right- or left-hand assembly. The versatile self-contained driving head is ideal for use in automatic assembly machines incorporating dials and straight-line transfers.

The Model U drives screws from #6 x 5/16" long to 1/4" x 1 1/2" long . . . and can be equipped with 12" or 16" barrel feeders.

DETROIT POWER SCREWDRIVER COMPANY
2799 W. Fort St. • Detroit 16, Michigan
A Subsidiary of Link-Belt Company
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DANA CORPORATION'S STANDARD EQUIPMENT DIVISION in Toledo, Ohio, announces the appointment of FRANK B. GRAPER to the post of assistant general manager, and of FRANK A. SALTZGIVER as manager of operations and distributor sales.

UNITED STATES DRILL HEAD CO., Cincinnati, Ohio, expects to occupy their new plant on the west side of the city by September 1. Construction is under way at the fourteen-acre site. This will mark completion of the three-quarter-million-dollar building program begun in 1957.

HENRY J. BRUCK has been appointed manager of crankshaft and boring lathe sales for the R. K. LEBLOND MACHINE TOOL CO., Cincinnati, Ohio.

LEO TOBACMAN has joined the staff of RANDOLPH MFG. CO., East Cleveland, Ohio, as chief engineer of its Airborne Mechanisms Division. The parent company is engaged in precision honing, lapping, and grinding.

W. D. COWGILL has been appointed to the post of general sales manager of the CLEVELAND GRAPHITE BRONZE DIVISION of the Clevite Corporation, Cleveland, Ohio.

JAMES G. GELDER has been named general manager of DIAMOND ELECTRONICS DIVISION of Diamond Power Specialty Corporation, Lancaster, Ohio.

CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio, gave notice that all sales activities will be consolidated into one sales department under ROBERT G. BIRKIN, general sales manager, and J. G. FRISCHKORN, sales manager.

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Since 1865

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For toolroom or job shop this MSO Universal Grinder with 7" x 12" capacity is unexcelled in sensitivity, accuracy, finish.

MODEL FMES
a true Universal Grinder
with compound swivel
wheelhead
fine in-feed to .00005"

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White Plains, New York

Pennsylvania, Maryland, and West Virginia

WALTER E. GREGG has been elected vice-president, technology, of CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa. Formerly director of technology, he takes over a position vacated last October when Maurice J. Day was named vice-president, commercial. In his new position, Mr. Gregg will direct research and product and process development activities, in addition to assuming responsibility for the company's metallurgical, patent, and license activities.

A. WILLIAM TILDER has been appointed general manager of the MORTON MACHINE WORKS DIVISION, Brubaker Tool Corporation, Millersburg, Pa.

EDWIN F. SHELLEY, president of USI Robodyne, Silver Spring, Md., has been appointed a group officer and vice-president of U. S. INDUSTRIES, INC. The new post will give Mr. Shelley executive supervision

Edwin F. Shelley, group officer and vice-president of U. S. Industries, Inc., president, Robodyne Division.

The Place of New Friendships Between Customers and Producers of the Five Continents.

INTERNATIONAL TRADE FAIR — BRNO — CZECHOSLOVAKIA

11th - 25th September, 1960

2,500,000 Visitors from 45 Countries.
Exhibitors from all Parts of the World.

Total Exhibition Area	*572,000 sq. yards*
Covered Exhibition Area	*82,500 sq. yards*

Products of the engineering and metallurgical industries, raw materials, semi-manufactures and durables are displayed by exhibitors from all parts of the world.

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offer in engineering—design the advance standards and the ultimate in precision for uninterrupted service. Our catalog #20 will guide your selection of bearings available for immediate delivery listing many standard sizes. May we be of service?

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Special and standard
PRECISION GEARS UP TO 200 DIAMETRAL PITCH
All Gears certified for Accuracy Quality and Fine Workmanship
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ALL TYPES MADE TO YOUR SPECS!
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ECONOMICAL
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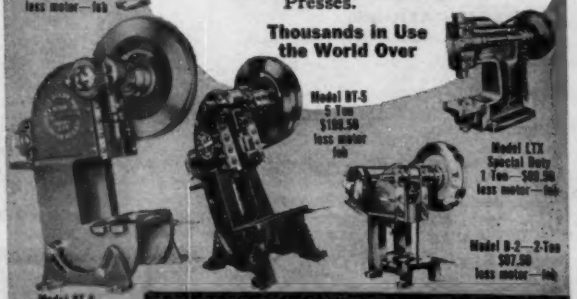
Hundreds of different Model Combinations 1 to 12 ton Capacities

See your Supply Dealer or write for Catalog giving complete information, specifications and prices on our line of Heavy Duty Punch Presses.

Thousands in Use the World Over



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Clinton, Missouri **Tel. TUrner 5-3331**

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over the USI Technical Center at Pompano Beach, Fla.; the USI Western Design Division at Santa Barbara, Calif; and the USI Office of Government Programs, New York City, in addition to the USI Robodyne Division which he has headed since 1958.

BLACK & DECKER MFG. CO., Towson, Md., and AMERICAN MACHINE & FOUNDRY CO., New York City, have agreed that the entire capital stock of DEWALT, INC., Lancaster, Pa., a subsidiary wholly owned by AMF, is to be transferred to Black & Decker in exchange for 120,000 shares of its stock. DeWalt subsidiary will operate independently of Black & Decker under the present management.

JOHN A. HELGESEN has been appointed as product applications engineer with MARBON CHEMICAL, division of Borg-Warner, Washington, W. Va.

Texas and Florida

J. A. GRUNDY has been appointed general manager of CELCO AIR TOOLS, a division of the Reed Roller Bit Co., Houston, Tex. His new duties are additional to those of vice-president, operations.

J. A. Grundy, vice-president, operations, Reed Roller Bit Co., and general manager of Cleco Air Tools.

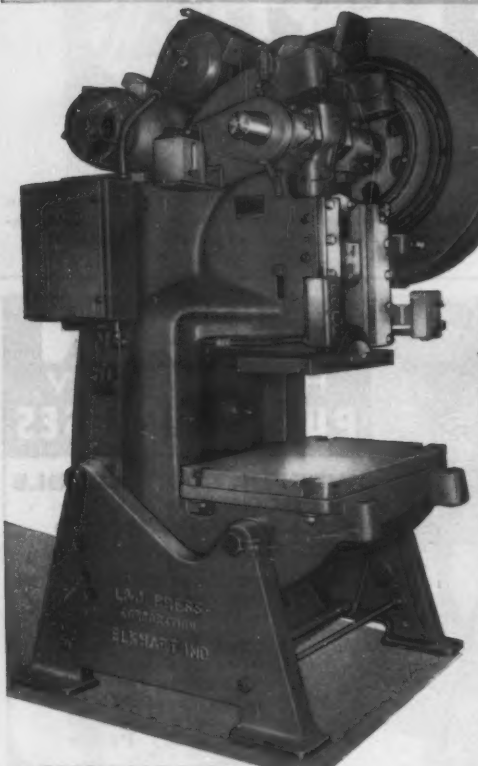
CLECO AIR TOOLS, a division of the Reed Roller Bit Co., has made five key promotions in its Houston, Tex., headquarters plant. Mr. M. D. HOZA is now in charge of research and development; Mr. G. A. BOYD is in charge of product and project engineering; Mr. G. G. WALKER is manager of air tools services; Mr. C. R. GASS is factory manager; and Mr. LEGARD MAY is now personnel manager.

RUSSELL, BURDSALL & WARD BOLT AND NUT CO., Port Chester, N. Y., and MODERN DESIGNERS, Hialeah, Fla., have affiliated to form INDUSTRIAL PLASTIC MOLDERS, INC., in Hialeah, to manufacture injection-molded plastic parts. RB&W holds controlling interest in the new company, to replace Modern Designers. Industrial Plastic Molders will also design and make custom molds for injection molding. MARTIN DAWSON, former head of Modern Designers, is president of the new corporation.

Wisconsin and Minnesota

GISHOLT MACHINE CO., Madison, Wis., announces the appointment of STAR MACHINERY CO., as its representative to handle distribution of the Gisholt line of machine tools. Star Machinery Co. maintains sales offices in Seattle and Spokane, Wash., and in Portland, Ore. Territory includes entire state of Washington except five southern counties; part of Idaho (north of, and including, Idaho county); and parts of Montana west of, and including, the

KEEP GOOD DIES GOOD



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50 SERIES PRESSES

- Capacity for large dies.
- Large box-type slide, mounted in long gibs, maintains accurate alignment.
- Rigid frame design resists deflection under heavy work loads.
- Dies mate perfectly — wear is minimized. Close product tolerances stay close. Die maintenance is reduced.
- Proven L&J features insure long dependable service, cut maintenance.
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SPECIFICATIONS
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Two capacities—50 or 60 tons, geared and non-geared models. Slide face 24" x 12". Bolster 36" x 24". Opening through back 22". Shut height 11"*. Slide stroke 4"*. Slide adjustment 3". *or to suit

Write for complete information. Also 14 to 150 ton O.B.I. presses, 20 to 150 ton straight side presses, and 30 to 75 ton gap frame presses.

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counties of Flathead, Lake, and Missoula. SOUTHWEST MACHINE TOOL CORPORATION in Phoenix has been appointed to handle distribution of the Gisholt line in Arizona.

George M. Class, vice-president and member of the board of directors, Gisholt Machine Co.

GISHOLT MACHINE CO., Madison, Wis., announces that GEORGE M. CLASS, vice-president and a member of the board of directors, will now devote his efforts to increased customer relations, patent administration, and special projects, as well as serving in a general advisory capacity. Mr. Class has been with the company for more than thirty-five years. He became vice-president in charge of engineering in 1955, and was elected to the board of directors in 1957.

GISHOLT MACHINE CO., Madison, Wis., announces the promotion of WERNER I. SENGER to vice-president, engineering. Mr. Senger's function will be the administration of all engineering for all products manufactured by the company, with the exception of those in the Plastics Division. He was previously vice-president in charge of balancing. Mr. Senger has been with Gisholt for more than forty-three years.

Werner I. Senger, vice-president in charge of engineering, Gisholt Machine Co.

RUSS A. HENKE has been appointed director of research by RACINE HYDRAULICS & MACHINERY, INC., Racine, Wis., in connection with a current expansion of the firm's research and development program. He was head of Russ Henke Associates, consulting firm at Elm Grove, Wis. Former associates are continuing that business under the name of Engineering Associates.

KEMPSMITH MACHINE CO., Milwaukee, Wis., announces the appointment of HARRY MUSSUN as director of machine tool sales.

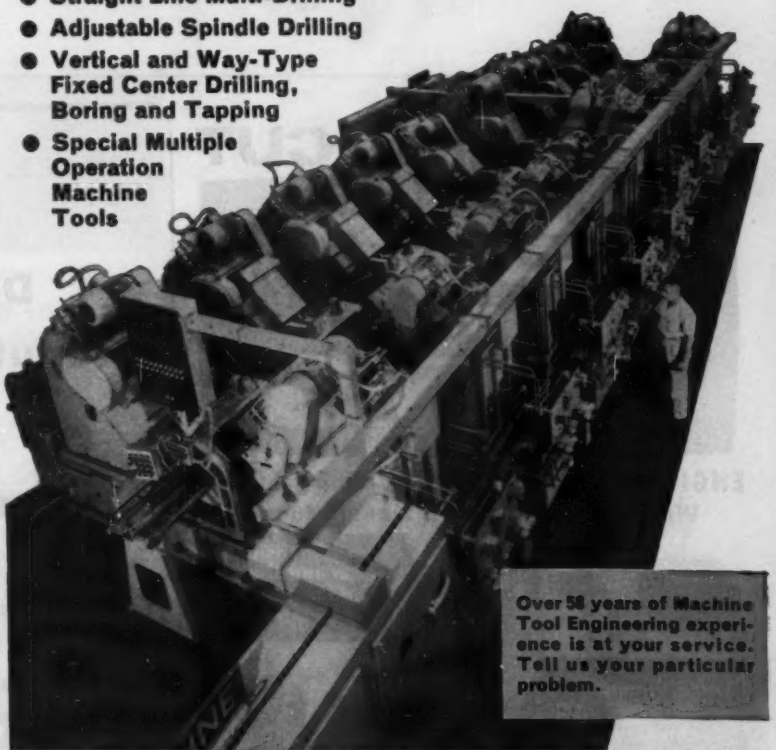
(Continued on page 244)

MOLINE

FOR GREATER | PRODUCTION • EFFICIENCY • SAVINGS

Use rugged, reliable "Hole Hog" machine tools for such jobs as:

- Multi-Spindle Boring
- Single and Multi-Spindle Honing
- Straight Line Multi-Drilling
- Adjustable Spindle Drilling
- Vertical and Way-Type Fixed Center Drilling, Boring and Tapping
- Special Multiple Operation Machine Tools



Over 58 years of Machine Tool Engineering experience is at your service. Tell us your particular problem.

112

Twenty-Station, Ten-Unit Transfer Machine for boring, counterboring, chamfering and valve clearance operations on V-8 automotive engine blocks. (Shown above)

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REPRESENTATIVES IN PRINCIPAL CITIES

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OWATONNA TOOL CO., Owatonna, Minn., announces the appointment of FRANCIS J. PAULER as industrial sales engineer. He will work closely with car, truck, tractor, and other equipment manufacturers in the design and application of the company's special manual and hydraulic maintenance tools.

Coming Events

SEPTEMBER 6-16—Machine Tool Exposition, sponsored by the National Machine Tool Builders Association, to be held at International Amphitheatre, Chicago, Ill. For more information: Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

SEPTEMBER 6-16—Production Engineering Show, to be held at Navy Pier, Chicago, Ill. For additional information, inquire of Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

SEPTEMBER 7-15—Second International Coliseum Machinery Show to be held at Chicago Coliseum, Chicago, Ill. For further information, write: A. Byron Perkins & Associates, 2807 Sunset Blvd., Los Angeles 26, Calif.

SEPTEMBER 11-20—German Machine Tool Exhibition to be held in Hanover, Germany, sponsored by Verein Deutscher Werkzeugmaschinenfabriken, Am Hauptbahnhof 6, Frankfort am Main, Germany. Requests for room reservations should be addressed to: Amt für Verkehrsförderung, Friedrichswall 5 (Laveshaus), Hanover, Germany.

SEPTEMBER 26-29—Fall Meeting American Welding Society to be held at Penn-Sheraton Hotel, Pittsburgh, Pa. For further information: American Welding Society, 33 W. 39th St., New York 18, N. Y.

OCTOBER 17-21—Forty-Second National Metal Exposition and Congress, sponsored by American Society for Metals, to be held at Philadelphia Trade and Convention Center, Philadelphia, Pa. For additional information: Chester L. Wells, exposition manager, American Society for Metals, Metals Park, Novelty, Ohio.

NOVEMBER 14-18—Third Western Tool Show sponsored by the American Society of Tool Engineers, to be held at the Memorial Sports Arena in Los Angeles, Calif. For additional information write Leonard Abrams, exposition manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.

Obituary

WILLIAM R. MOORE, former Norton Co. vice-president, died in May at the age of sixty-nine. He had been living in Clearwater, Fla., since his retirement in 1956. Mr. Moore was connected with the Norton Co. forty-two years, a vice-president for thirteen. He was active in many civic affairs; he was director of National Sales Executives Inc. for four years.

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Custom Gears Exclusively

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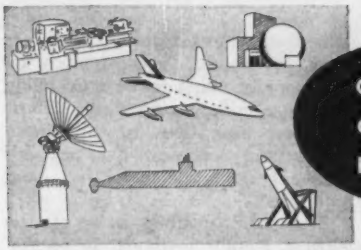

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ON SEA
IN SPACE

Performance is Better with

JERPBAK BAYLESS

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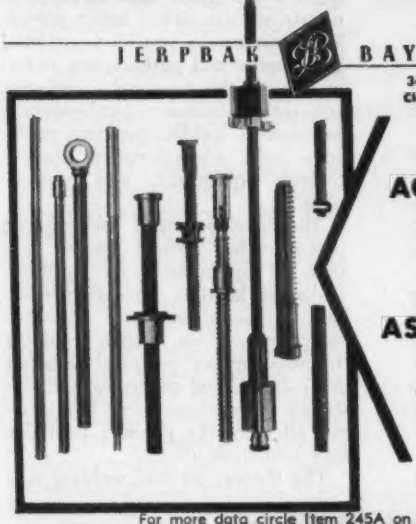

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Hold precision tolerances and make faster set-ups by installing the Roby Patented Precision Turret Lathe Carriage Stop. Installation is easy . . . quick. Send for bulletin.

ROBY MACHINE WORKS

P. O. Box 46 **Truro, Iowa**

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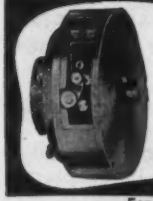

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ON BORING MILLS - DRILLS - LATHES MILLERS AND RADIALS

M-D facing Head feeds automatically. Lathe tool bit travels radially from center outward or reverse. 10 sizes, 6" to 46" dia. Write for bulletin, prices.

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DO YOU BEND? CUT?

"A MANUAL OF PROCESS for THE COLD BENDING OF METALS and ABRASIVE CUT-MACHINING OF METALS" gives practical advice on all phases of cold bending and abrasive cutting. Simply written by shop men for shop men. Price $3.00.

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Here, in a phrase, is your assurance of precision excellence of crankshaft production . . . profit-making production with lower initial and unit costs on every job . . . guaranteed by engineering competence and versatility that is responsible for producing the world's only complete line of crankshaft lathes. WICKESmanship symbolizes the prime factor for our continued growth in 105 years of customer satisfaction. WICKESmanship stands for the kind of technical superiority and unsurpassed quality that is always ready to help solve your toughest crankshaft production problems.

Your WICKESman is the symbol of technical efficiency with its sleeves rolled up—call him today.

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WICKES MACHINE TOOL

ESTABLISHED 1854 DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN, U. S. A.

CRANKSHAFT LATHES • SMALLEY GENERAL THREAD MILLERS • ENGINE LATHES CENTER DRIVE LATHES, AND BORING MACHINES • SPECIAL MACHINES

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New Books and Publications

WELDING HANDBOOK: Section III of Fourth Edition. Edited by Arthur L. Phillips. 512 pages; 355 illustrations; 78 tables; indexed; 6 by 9 inches; cloth. Published by the American Welding Society, 33 W. 39th St., New York 18, N. Y. $9.

Special welding and metal-joining processes are covered in Section III of this Welding Handbook. The volume contains chapters on oxygen cutting and arc cutting. Especially noteworthy are chapters on welding plastics, the adhesive bonding of metals, and the new method of welding by cold-working.

This new section of the Welding Handbook might be called a catch-all. However, the special welding and joining operations covered are among the newer and more vigorous areas of the metalworking art, not to be regarded as odd-balls in any sense of the term.

Section III also contains chapters on: forge welding; thermit welding; induction welding; hard surfacing; metallizing; brazing, soldering; welding of plastics; adhesive bonding of metals; oxygen-cutting and auxiliary oxygen-cutting processes; arc cutting; ultrasonic welding; welding by cold-working; and stud welding.

The chapter on soldering contains some of the most advanced information ever published, covering details of techniques used in abrasion soldering and ultrasonic soldering.

The tremendous development of plastic materials has caused both the application and fabrication of plastic products to boom. Exhaust ducting pipe and pipe fittings, tanks and structural applications all require welding. These are typical case areas explored on the welding of plastics. Contents include: definition and general description; identification of thermoplastic materials; an extensive list of definitions; friction welding; hot gas welding; equipment; design; materials; and testing.

Adhesives have become recognized structural materials and are given a chapter. Approximately 60 per cent of the aircraft now being built use adhesive bonding. This is the first time that extensive non-commercial technical data on adhesive bonding of metal has been published.

Ultrasonic welding, one of the newest joining methods, is accomplished by introducing high-frequency vibrations into overlapped metals at the areas being joined. Welds are produced with no external heat source and without any deformation of the base-metal surfaces. Information includes: fundamentals, base-metals welded; welding methods; weld characteristics; quality control; equipment; and applications.

The development of cold-welding processes has opened several new areas of application; for instance, solderless, heatless connections common to the assembly of transistor components. This chapter contains the most recent technical data on the cold-welding processes and describes: fundamentals of the process; effect of the process; joint design; and applications.

The chapter on stud welding was

LW
DIVIDING HEADS
Accurate, Heavy Duty
Ball bearing thrust on worm shaft and rear end of spindle.
Headstock spindle has threaded nose.
Large tapered bearing adjustable for end play. Head tilts past 90°.
Worm wheel and alloy stress-proof steel worm cuts to close limits for accuracy.
Worm wheel and worm shaft can be fully disengaged.
Complete with three index plates for dividing all numbers
to 50 and even numbers to 100 except 98. Index chart shows all divisions
obtainable to 380. Specify left (illustrated) or right hand model.
SWIVEL BASE, RISING BLOCKS AND DIRECT INDEXING
MODELS AVAILABLE ON ALL SIZES.
MODEL SD 6½" Swing. Spindle threaded 1½"-8. ⅝" table slot tongues. 36 lbs. $175.00
MODEL BP 11" Swing for plain milling machines. Spindle threaded 2¼"-10. ⅝" table slot tongues. 140 lbs. $295.00
MODEL AU 11" Swing. Fully universal for complete indexing and spiral cutting. Spindle threaded 2¼"-10. ⅝" table slot tongues. 190 lbs. $460.00
America's Largest Builders of Dividing Heads
LATHE CHUCKS
LW CHUCK COMPANY
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MAGNETIC CHUCKS
MILLING MACHINE VISES
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STANDARD ZAGAR Gearless DRILL HEADS
DRILL ANY NUMBER OF HOLES IN ANY PATTERN IN ANY MATERIAL ON ALL CENTERS

Write for Manual M-7

Drill a maximum number of holes in one pass—in any material. Holes can be as close as twice drill diameter. Zagar gearless drillheads are built as a complete unit or may be adapted to any standard drill press. Send us your part drawing and we will submit our quotation.

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Zagar INCORPORATED
USE MORE SPINDLES TO DO MORE WORK
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originally scheduled for Section II of the Handbook, but it was held over for Section III in order to include techniques which were then still in the development stage. This chapter contains information on all existing methods and equipment, as well as information on some equipment not previously announced.

DISTORTION IN TOOL STEELS. By Bernard S. Lement. 173 pages; many illustrations, tables, and graphs; indexed; 6 by 9 inches; cloth. Published by the American Society for Metals, Novelty, Ohio. $10.

The manufacturers of heat-treated steel parts and tool steels are concerned with the practical aspects of dimensional changes that occur in phase transformation. Metallurgists, employed by steel companies, must develop and produce high-quality tool steels with a chemical composition that allows some degree of control over dimensional changes. Salesmen must know what dimensional changes are likely to occur in various heat-treated tool-steel components.

Major practical interest in dimensional changes comes from manufacturers of precision tool-steel parts. It is now common practice to design tool-steel parts to tolerances between 10 to 100 micro-inches. Hence, economical manufacturing demands a way of selecting steels that permit predictability of inevitable dimensional changes. Thus, "green" dimensions can be established that minimize postheat-treating costs for grinding and honing, while providing assurance that final part dimension will not change significantly through aging in storage or service.

Dr. Lement's new book covers such aspects of tool-steel distortion as: its nature, measurement, and testing; quantitative prediction; control; relation to specific heat-treating operations; and occurrence on aging. He stresses the selection of tool steels offering the most desirable size and shape stability for specific applications. He has included data on changes in shape and size of tool-steel parts of various chemical analyses and designs. The metallurgical principles necessary for both qualitative and quantitative understanding of the subject are explained and discussed. The author does a good job of highlighting the practical aspects of this highly technical subject, keeping mathematical analysis needed for effective presentation to the minimum.

MOTOR SELECTION AND APPLICATION. By Charles C. Libby. 508 pages; numerous illustrations and sketches; 49 tables; indexed; 6 by 9 inches; cloth. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $13.50.

This is an authoritative reference work dealing with electric motor selection for specific industrial services in terms of load characteristics, service requirements, space limitations, duty-cycle requirements, and safety. The author is manager of the electrical department of Fairbanks, Morse & Co., and has many years of experience serving his company's heavy industrialized territories. He is well qualified as an authority.

Charts, tables, and other graphics in the book relate motor load variables to motor characteristics. Thus mechanical engineers, machine designers, production executives, master mechanics, and other interested personnel can achieve the most economical, smallest, lightest, and lowest maintenance rotary electrical equipment for the task to be per-

A Grieder Tube Cut-Off Machine will produce 4500 to 6500 cut-offs per hour

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formed. Motor-temperature rise, as a key factor in determining motor life, is discussed in relation to motor insulation, temperature, and various load cycles. The latter includes continuous load, intermittent load, and reversing cycles. The text covers load-torque characteristics for induction, synchronous- and direct-current motors. Motor enclosures, as protection for all types of industrial motors, are carefully analyzed.

The data given in this text covers industrially accepted standards of American Standards Association, American Institute of Electrical Engineers, and National Electrical Manufacturers Association.

Corrosion Problems Subject of Four-Day Discussion

Corrosion problems in all fields of industry was the subject of the recent annual Sea Horse Institute Meeting sponsored by the International Nickel Co., Inc., New York City. This year's informal meeting took place in Wrightsville Beach, N. C., and spanned four days.

Among the topics on the agenda—which covered a wide range of interests—were metals, coatings, cathodic protection, and other miscellaneous aspects of corrosion and cavitation problems. Under the general heading of coatings, some details covered were the types of coatings that can be expected to provide the best adhesion to metal structures which are exposed while under stress, and chemical interreaction between a steel surface and inorganic or organic surface treatments. One interesting subject of discussion under the category of metals was the performance, under marine exposure, of materials fabricated by powder metallurgy, as compared to those fabricated by conventional methods.

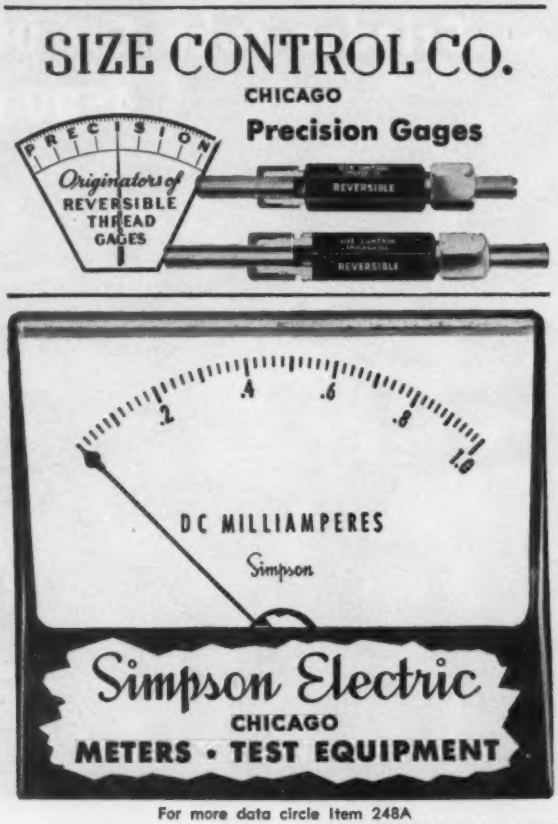
More than 200 persons attended the series of conferences. Among them were scientists and engineers from the Canal Zone, British Columbia, Ontario, Nova Scotia, Canada, and most parts of the United States.

Methods of Extruding Beryllium for Aircraft Use

Techniques for the extrusion of beryllium have been developed by the Norair Division of the Northrop Corporation, Hawthorne, Calif. Working under contract with the U. S. Air Force Air Materiel Command and assisted by Nuclear Metals, Inc., Concord, Mass., Norair has produced U-shaped beryllium parts 15 feet long and 1/8 inch thick. Development of the new methods, however, is expected to make beryllium extrusions in all sizes, shapes, and lengths available to aircraft and space-vehicle makers within two years.

To achieve beryllium extrusions, proper lubricants and tooling had to be devised. In addition, safeguards had to be provided against the lethal fumes beryllium emits at extruding temperatures.

In the extrusion process, a beryllium billet is heated to temperatures up to 2000 degrees F. and forced through dies at pressures up to 1700 tons. Glass was chosen as the best lubricant after much experimentation.



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Research Breakthrough in Refractory Materials

A number of refractory metals and metallic compounds are now being grown in the form of large single crystals by the Linde Company, Division of Union Carbide Corporation. The crystal-growing process is being used to grow refractory crystals such as tungsten, molybdenum, tantalum, columbium, vanadium, titanium carbide, titanium diboride, columbium carbide, molybdenum disilicide, titanium monoxide, and titanium sesquioxide. Other substances can be similarly produced. The crystals are formed as cylinders in diameters of 1/4 inch to 1 inch and in lengths of from a few inches to over a foot.

The arc fusion process employed for the purpose outlined is similar in some respects to the Verneuil flame fusion process used in Linde's commercial production of synthetic sapphire and star sapphire, rutile, and other oxide crystals. Thus, a primary advantage of the Verneuil process is retained—the fact that no container for the molten substance is required. Important process advantages are obtained through the wider range of temperatures and atmospheres obtainable with electric arcs as opposed to combustion flames.

Machining of tungsten and other refractory materials is possible at significantly lower temperatures than before as a result of the development of large crystals. For example, it is possible to tap threads in a tungsten blank at room temperature.

• • •

Precoating Metals to Prevent Oxidation and Material Loss

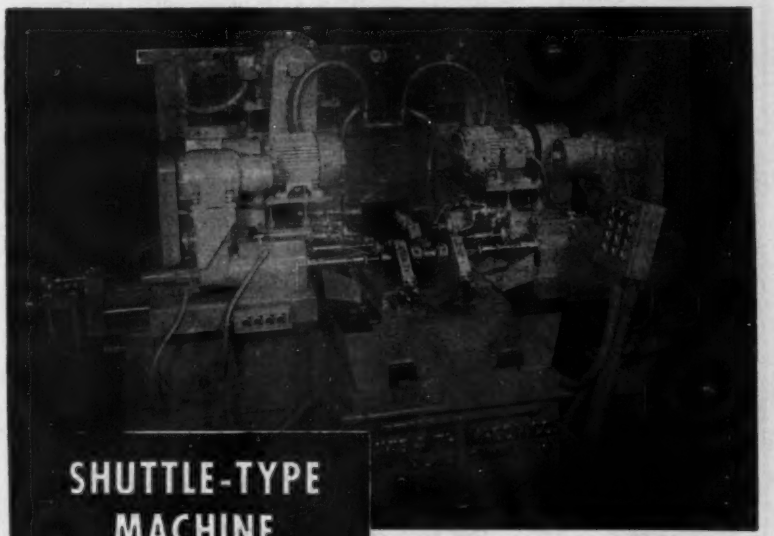
A method of precoating metals used in aircraft production to prevent oxidation and material loss during thermal-treating has been developed by the Aeronautics Division of Chance Vought. Patent applications are pending on the process by which copper or aluminum is sprayed on a metal before treatment. The copper or aluminum produces an oxide coat which protects the metal part from damage during hot-forming, stress-relieving, heat-treating, or annealing.

The precoat also forms a lubricant for subsequent forming, stops oxidation of the metal, and is easily removed after thermal treatment. Many close-tolerance parts previously were rejected because of metal loss of from 0.002 to 0.012 inch during stress-relieving. With application of the precoat, loss of material is maintained between 0.0001 and 0.005 inch.

In addition to various ferric materials and ferrous alloys, the process is valuable in protecting space-age metals such as beryllium, columbium, molybdenum, rhenium, tantalum, tungsten, vanadium and zirconium, as well as nickel alloys.

Vinyl-Metal Laminates Up 14 Per Cent in 1959

Production of vinyl-metal laminates amounted to about 12,000,000 square feet in 1959, which is a 14-per cent increase over the previous year despite the recent steel strike. These figures were announced by the Vinyl-Metal Laminators Institute of the Society of Plastics Industry, Inc. The laminates are used in such products as table tops, automobile interior parts, trays, air conditioners, and radio and television cabinets.



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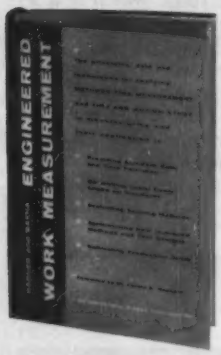

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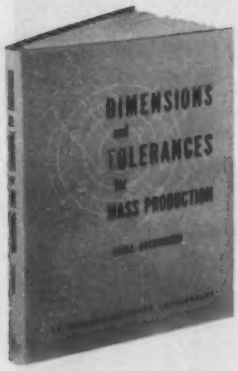

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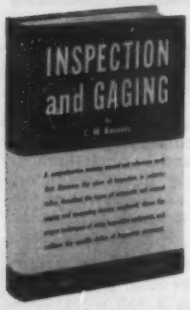

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DO YOU HAVE
THE ASSIGNMENT TO
"BUY A BENDING MACHINE?"

For bus bars?
For thin wall tube?
For pipe?
For structural shapes?

Or is it a rolling machine?
To coil tube or pipe sections?
Or perhaps a ram bender?

WHATEVER IT IS...

WALLACE — with over 64 years in the field — could help you in this important job!

For over 20 years ED PTACK'S JOB has depended on how well he — and those working with him — matched machines to the jobs of thousands of Happy Wallace Bender users!

Best proof of *how well he does?*
CALL HIM!
He's here! He's waiting to help you before you commit yourself.

WALLACE
SUPPLIES MFG. COMPANY
1310 West Diversey Parkway
Phone BUckingham 1-7000 (Collect, as we said before)
Chicago 14, Illinois

For more data circle Item 254A on Card

General-Purpose GEARS

Gears for general purposes or highly specialized applications are all in the day's work at Stahl. Representative of the painstaking precision embodied in ALL Stahl gears are these steel spurs—54" O.D., 9" F., 6¼" B., 52 T., 1 D.P., and steel spur pinions—14" O.D., 9" F., 6" B., 12 T., 1 D.P. Teeth are flame-hardened. Be sure of unfailing accuracy and prompt delivery—get Stahl's estimate.

SPURS TO 72" PD. 1 DP
BEVELS TO 54" PD. 1 DP
SPIRAL, HELICAL and WORM GEARS TO 48" PD. 2 DP
CONTINUOUS TOOTH HERRINGBONE TO 60" PD. 2 DP
SPROCKETS TO 72" PD. 2 DP
RACKS TO 20 FT. LONG. 3 DP
SILENT GEARS: RAWHIDE, BAKELITE, FIBROID
HEAT TREATED, CASE OR FLAME HARDENED GEARS—OF CARBON OR ALLOY STEEL

Stahl
GEAR & MACHINE COMPANY
3901 HAMILTON AVENUE
CLEVELAND 14, OHIO

For more data circle Item 254B on Card

DYKEM STEEL BLUE
Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME
END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

THE DYKEM CO., 2303R NORTH 11TH ST., ST. LOUIS 6, MO.

For more data circle Item 254C on Card

JIG AND FIXTURE DESIGN
A practical book with 382 pages of information on the design and construction of jigs and fixtures for drilling, boring, planing and milling. $5 per copy. Sent on approval.
MACHINERY, 93 Worth St., New York 13, N. Y.

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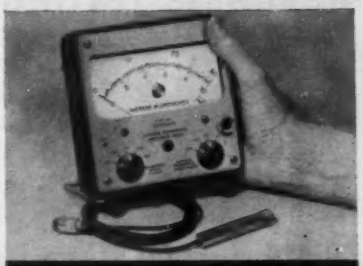
New METROsurf* surface roughness indicator



You can hold it in one hand and...

Work with it at the machine.

Battery-powered or AC line operated, rugged AIL METROsurf, Type 180 measures surface finish directly in average microinches — quickly easily, accurately and economically ...Only $495.00

For an informative 4-page folder, call your Cutler-Hammer Sales Engineer or write:

*Trade Mark

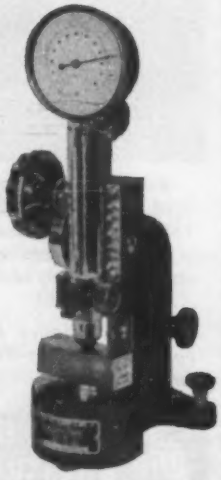
AIRBORNE INSTRUMENTS LABORATORY
DEER PARK, LONG ISLAND, NEW YORK
A DIVISION OF CUTLER-HAMMER, INC.

Circle this page number on card

"SHORE for SURE"

HARDNESS TESTING

Shore's Improved Direct Reading Scleroscope (above) and Standard Recording Scleroscope (below) with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.



Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

Standard Recording Scleroscope (right) with Clamping Stand, jaw capacity 3" high x 2½" deep. Supplied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case

THE SHORE INSTRUMENT and MANUFACTURING Co., Inc.

90-35 Van Wyck Expressway, Jamaica 35, N. Y.

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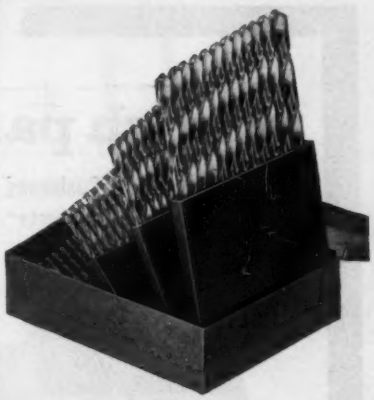
Hardened, Tempered and Ground-from-the-Solid!

It pays to specify

ACE

DRILLS
REAMERS
BLANKS

Premium Quality High Speed Steel, Solid Carbide and Carbide Tipped.



ACE DRILL SETS
Standard stock sets include Fractional, Wire and Letter size drills, packaged in convenient folding index cases.

ACE BLANK SETS
Uniformly hardened high speed steel reamer and drill blanks precision ground to new close tolerance limits available in standard Fractional, Wire and Letter series sets.

Call your local distributor today—or write Ace direct for latest catalog and price information.

ACE DRILL
Adrian, Michigan

ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

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AIR-CUSHIONED
vibration

Finish parts up to 100 times faster!

The Pangborn Air-Cushioned Vibratory Finishing Machine—culmination of Pangborn's years of experimentation and refinements*—is perfect for cleaning, descaling, radiusing, fine-finishing or burnishing metal and metal alloy parts, many suitable plastic and ceramic items.

*Pat. No. 2,422,786; June 24, 1947

- Works up to 100 times faster than conventional methods at lower cost
- Most compact vibrator on the market
- Air cushion suspension gives automatic leveling and amplitude control
- Does finishing work impossible to do by other means

In a wide range of sizes. Also auxiliary equipment, media and compounds for every need. Send parts with exact finish specifications, or finished specimen, for sample processing in our laboratory, to: Mr. William E. Brandt, PANGBORN CORPORATION, 1200 Pangborn Blvd., Hagerstown, Md.

Pangborn
OF HAGERSTOWN

Find sources for more data, quickly, easily. Use MACHINERY'S product index on preceding pages. Advertisers in this issue are listed alphabetically by product. Page numbers following company names indicates both location of ad and number to be circled on cards for more data.

feel free to use cards below . . .

to obtain free literature on products advertised or described in this issue

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3. Mail . . . we'll do the rest.

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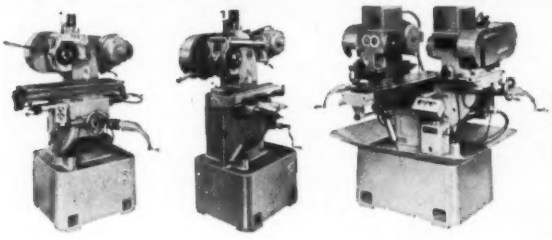

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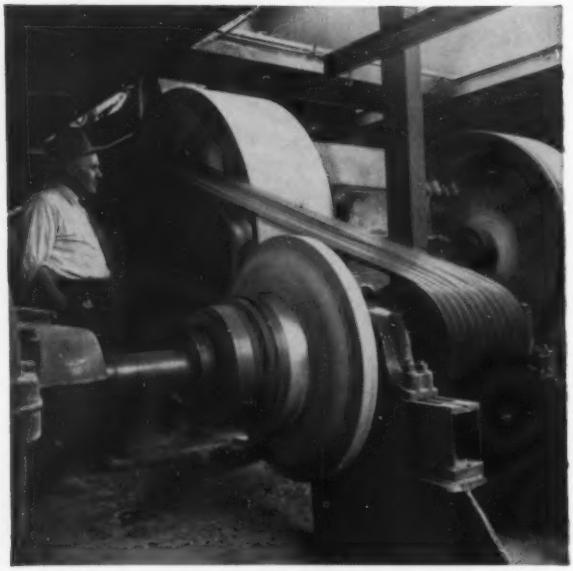

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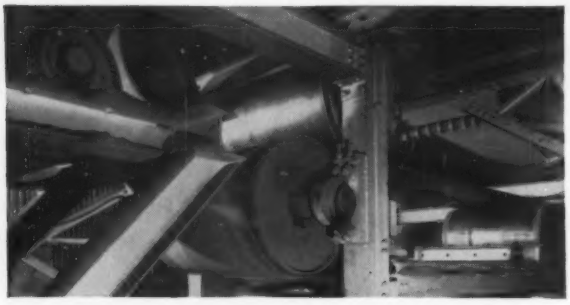

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